

# CD54HC190, CD74HC190 CD54HC191, CD74HC191, CD54HCT191, CD74HCT191 SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL

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- 2-V to 6-V  $V_{CC}$  Operation ('HC190, 191)
- 4.5-V to 5.5-V  $V_{CC}$  Operation ('HCT191)
- Wide Operating Temperature Range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$
- Synchronous Counting and Asynchronous Loading
- Two Outputs for n-Bit Cascading
- Look-Ahead Carry for High-Speed Counting
- Balanced Propagation Delays and Transition Times
- Standard Outputs Drive Up To 15 LS-TTL Loads
- Significant Power Reduction Compared to LS-TTL Logic ICs

CD54HC190, 191; CD54HCT191 . . . F PACKAGE  
CD74HC190 . . . E, NS, OR PW PACKAGE  
CD74HC191, CD74HCT191 . . . E OR M PACKAGE  
(TOP VIEW)



## description/ordering information

The CD54/74HC190 are asynchronously presettable BCD decade counters, whereas the CD54/74HC191 and CD54/74HCT191 are asynchronously presettable binary counters.

Presetting the counter to the number on preset data inputs (A–D) is accomplished by a low asynchronous parallel load (LOAD) input. Counting occurs when LOAD is high, count enable (CTEN) is low, and the down/up (D/U) input is either high for down counting or low for up counting. The counter is decremented or incremented synchronously with the low-to-high transition of the clock.

## ORDERING INFORMATION

| $T_A$  | PACKAGE†   |   | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|--|------------|---|-----------------------|------------------|
| $-55^{\circ}\text{C}$ to $125^{\circ}\text{C}$ | PDIP – E   | Tube of 25                                | CD74HC190E            | CD74HC190E       |
|  |            |   | CD74HC191E            | CD74HC191E       |
|  |            |   | CD74HCT191E           | CD74HCT191E      |
|  | SOIC – M   | Tube of 40<br>Reel of 2500<br>Reel of 250 | CD74HC191M            | HC191M           |
|  |            |   | CD74HC191M96          |                  |
|  |            |   | CD74HC191MT           |                  |
|  |            |   | Tube of 40            | CD74HCT191M      |
|  | SOP – NS   | Reel of 2000                              | CD74HC190NSR          | HC190M           |
|  | TSSOP – PW | Tube of 90<br>Reel of 2000<br>Reel of 250 | CD74HC190PW           | HJ190            |
|  |            |   | CD74HC190PWR          |                  |
|  |            |   | CD74HC190PWT          |                  |
|  | CDIP – F   | Tube of 25                                | CD54HC190F3A          | CD54HC190F3A     |
|  |            |   | CD54HC191F3A          | CD54HC191F3A     |
| CD54HCT191F3A                                  |            |   | CD54HCT191F3A         |                  |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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**TEXAS  
INSTRUMENTS**

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**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**



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**description/ordering information (continued)**

When an overflow or underflow of the counter occurs, the MAX/MIN output, which is low during counting, goes high and remains high for one clock cycle. This output can be used for look-ahead carry in high-speed cascading (see Figure 1). The MAX/MIN output also initiates the ripple clock ( $\overline{RCO}$ ) output, which normally is high, goes low, and remains low for the low-level portion of the clock pulse. These counters can be cascaded using  $\overline{RCO}$  (see Figure 2).


If a decade counter is preset to an illegal state or assumes an illegal state when power is applied, it returns to the normal sequence in one or two counts, as shown in the state diagrams (see Figure 3).

**FUNCTION TABLE**

| INPUTS            |                   |                  |   | FUNCTION            |
|-------------------|-------------------|------------------|---|---------------------|
| $\overline{LOAD}$ | $\overline{CTEN}$ | $D/\overline{U}$ | CLK   |                     |
| H                 | L                 | L                |  | Count up            |
| H                 | L                 | H                |  | Count down          |
| L                 | X                 | X                | X   | Asynchronous preset |
| H                 | H                 | X                | X   | No change           |

$\overline{D/\overline{U}}$  or  $\overline{CTEN}$  should be changed only when clock is high.

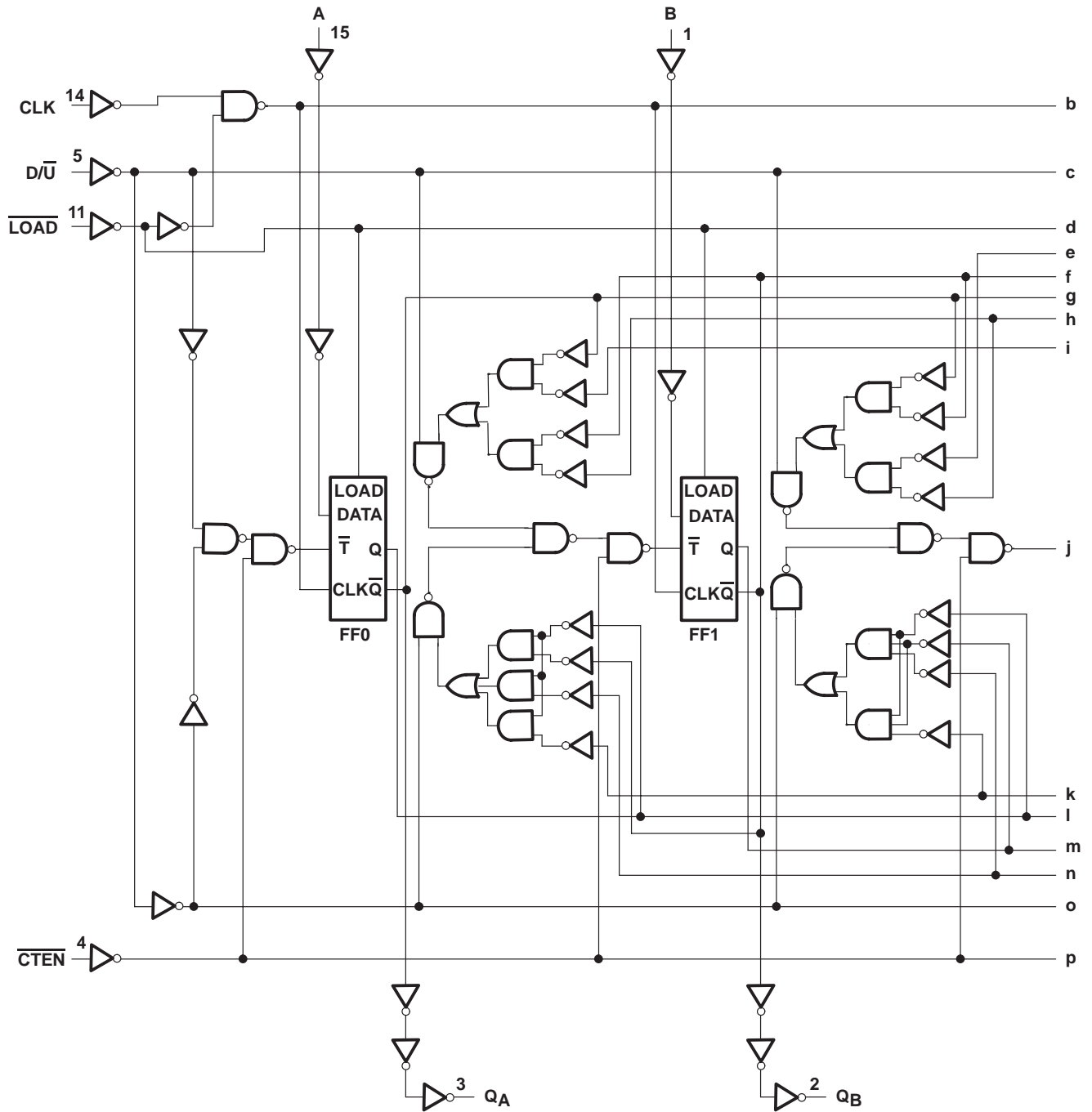
X = Don't care

 Low-to-high clock transition

**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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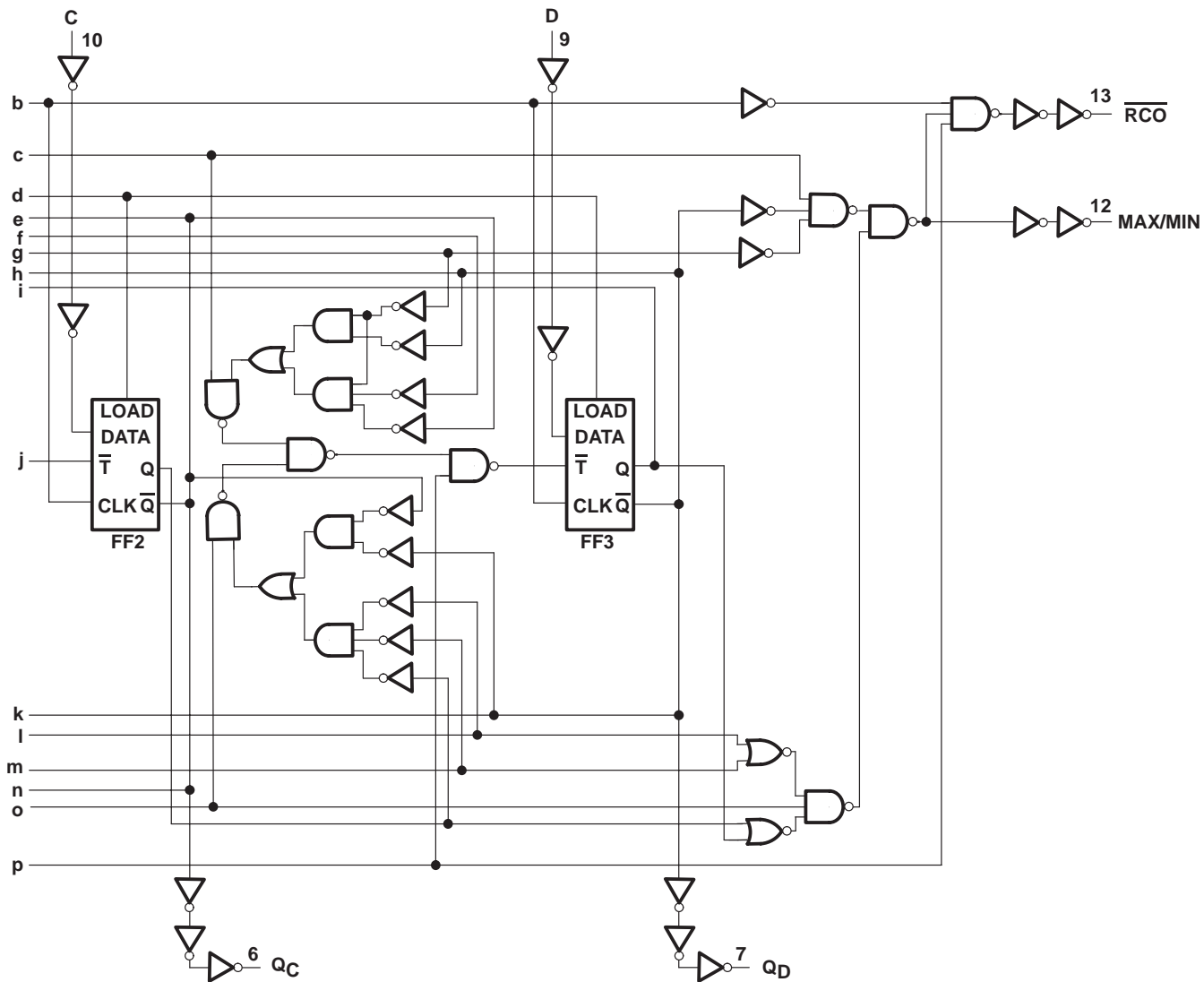
'HC190 logic diagram



**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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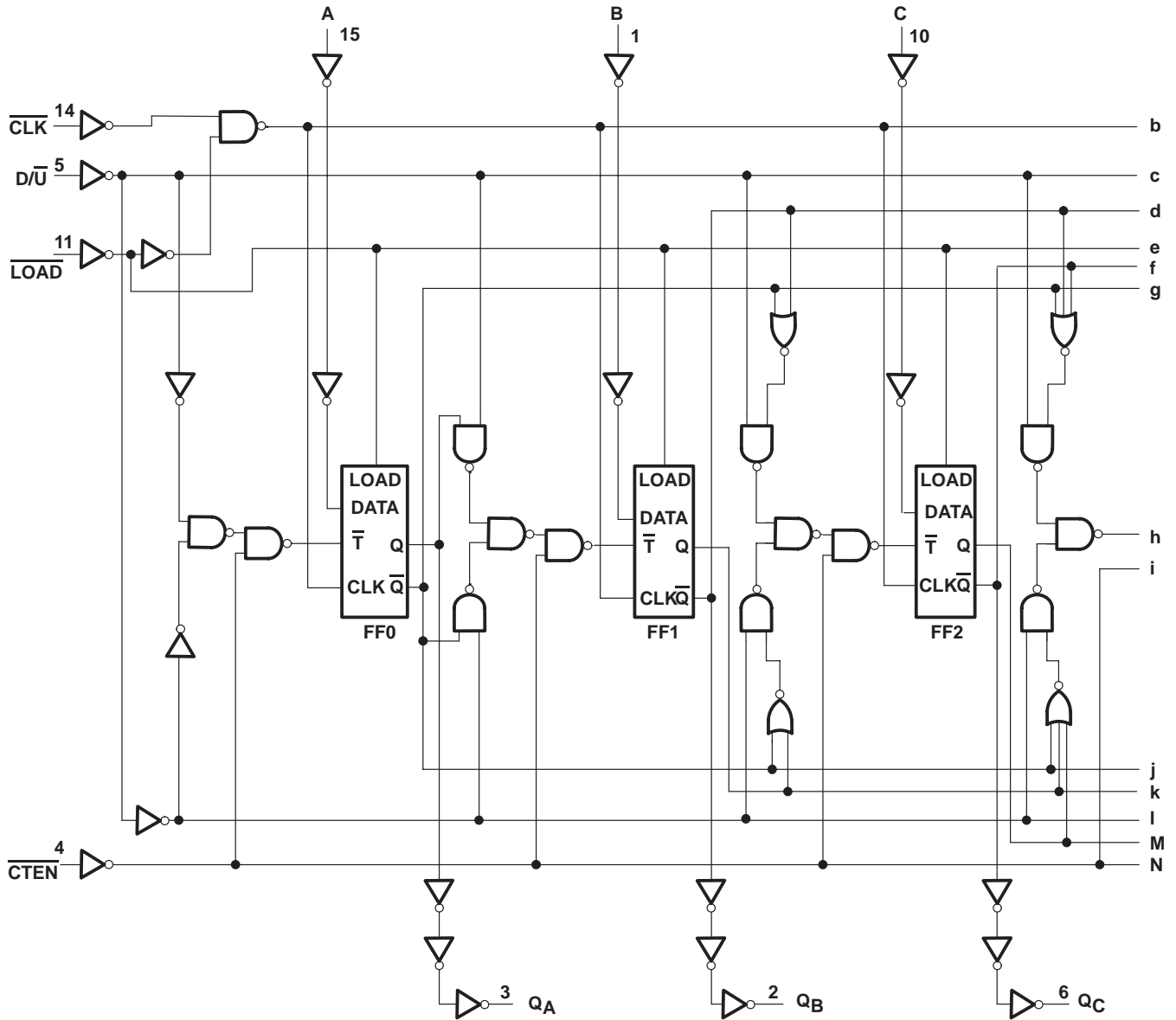
'HC190 logic diagram (continued)



**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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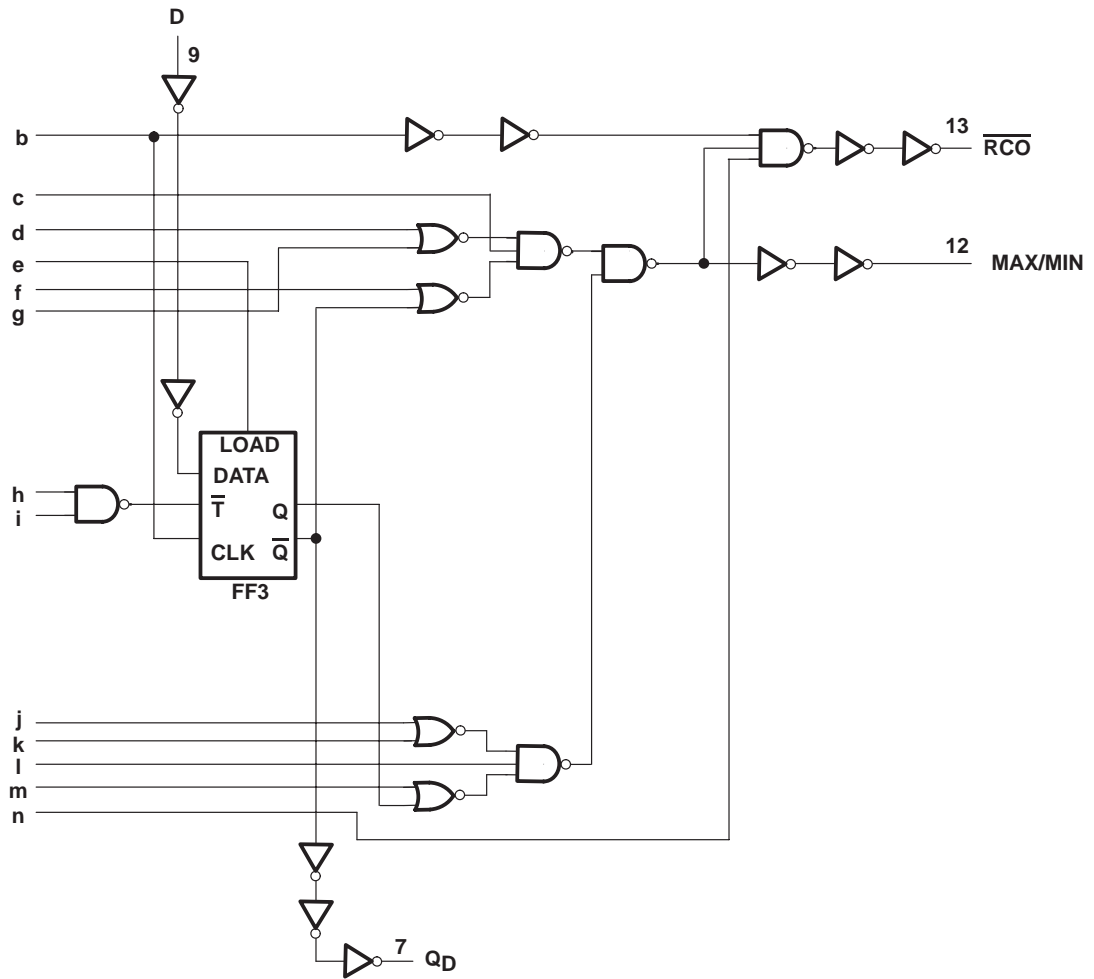
'HC191, 'HCT191 logic diagram



**CD54HC190, CD74HC190  
 CD54HC191, CD74HC191, CD54HCT191, CD74HCT191  
 SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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'HC191, 'HCT191 logic diagram (continued)





**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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**typical load, count, and inhibit sequence for 'HC190**

The following sequence is illustrated below:

1. Load (preset) to BCD 7
2. Count up to 8, 9 (maximum), 0, 1, and 2
3. Inhibit
4. Count down to 1, 0 (minimum), 9, 8, and 7





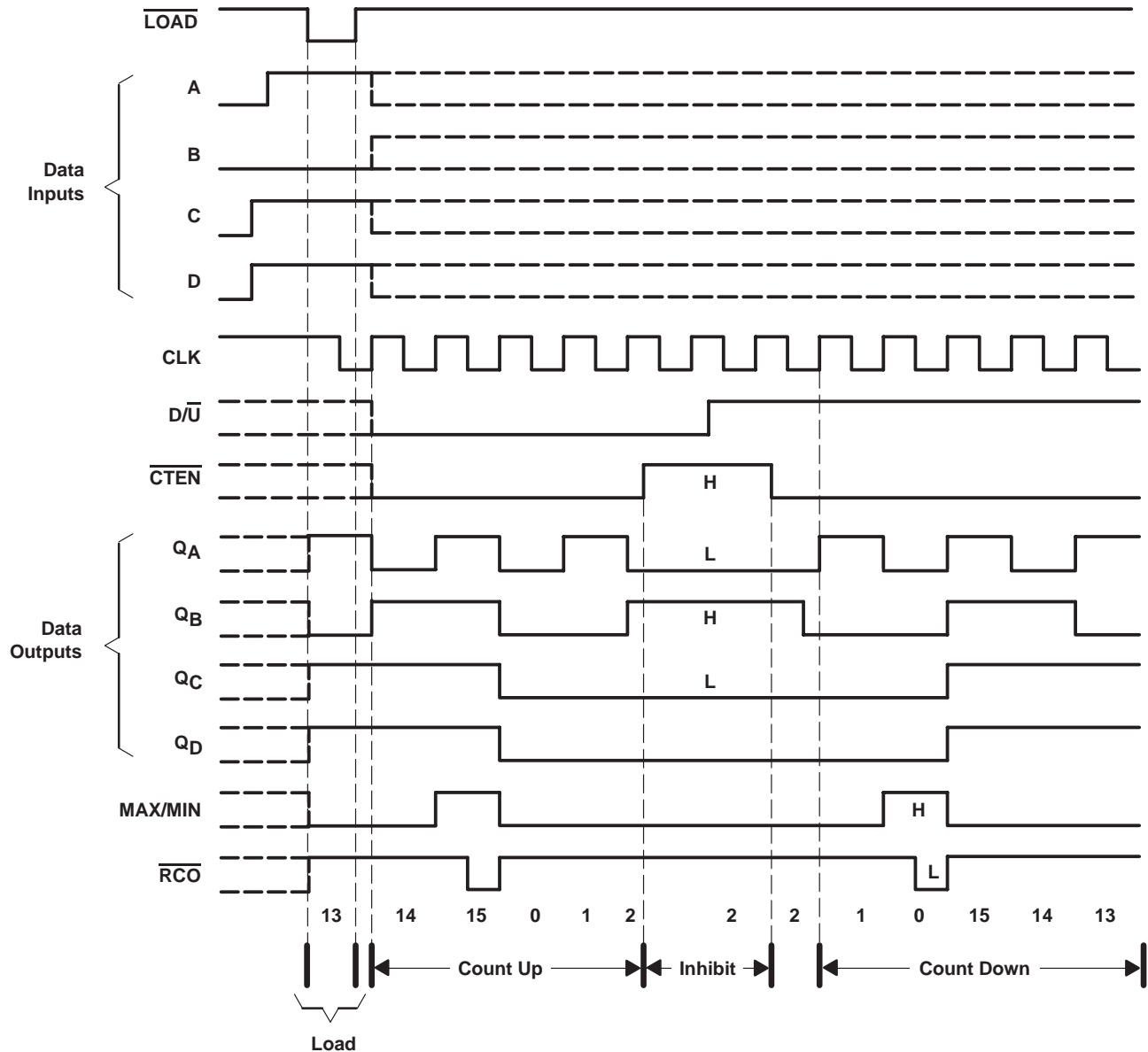
**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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**typical load, count, and inhibit sequence for 'HC191 and 'HCT191**

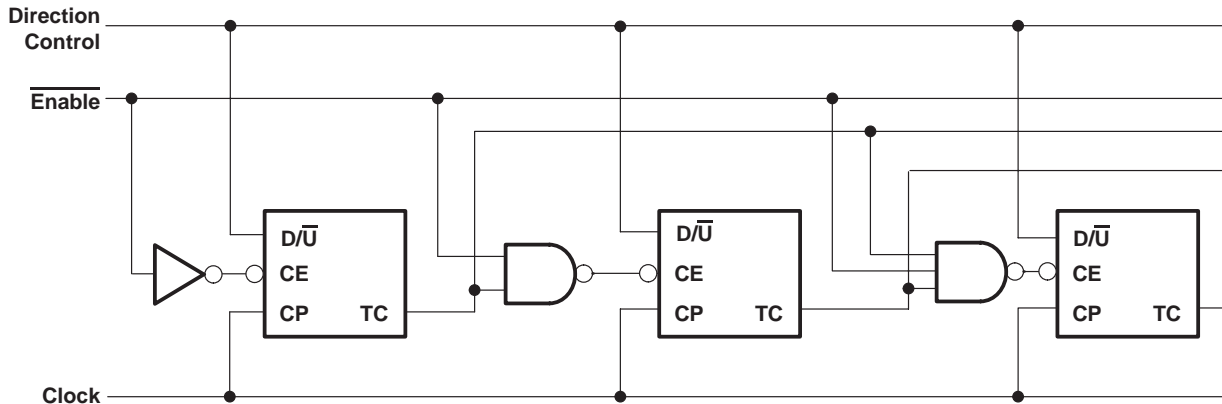
The following sequence is illustrated below:

1. Load (preset) to binary 13
2. Count up to 14, 15 (maximum), 0, 1, and 2
3. Inhibit
4. Count down to 1, 0 (minimum), 15, 14, and 13

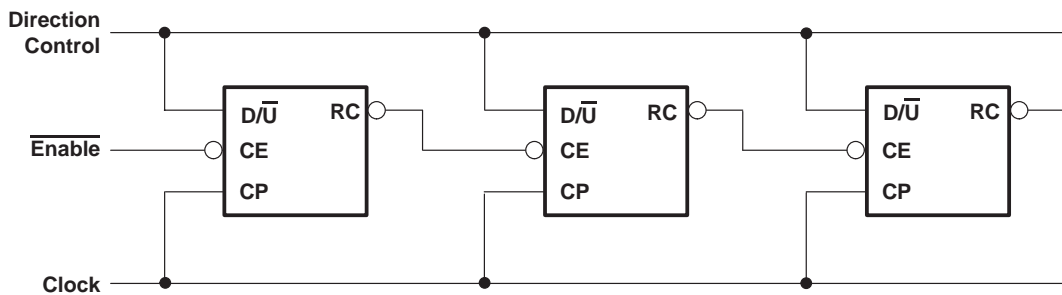


**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

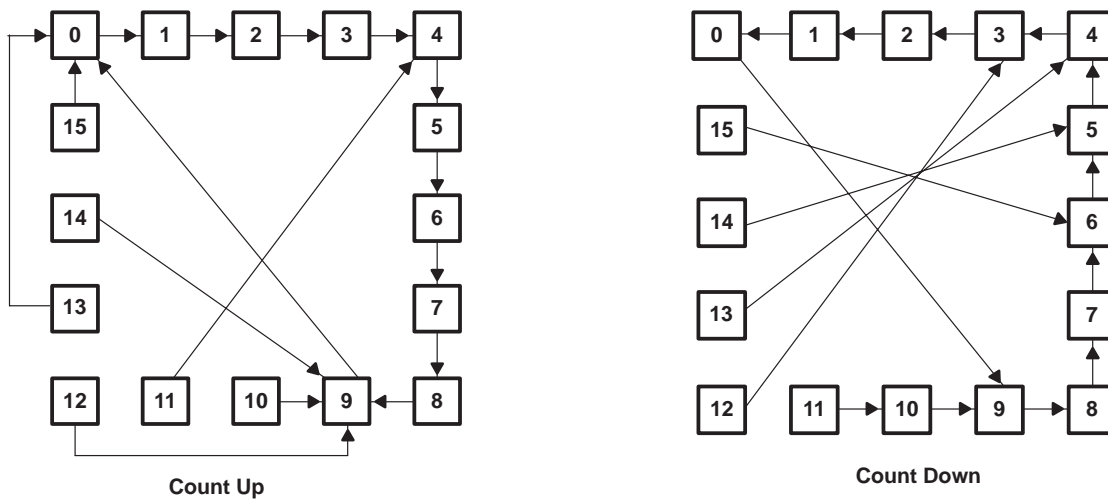
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**Figure 1. 'HC190 Synchronous n-Stage Counter With Parallel Gated Terminal Count**



**Figure 2. 'HC191, 'HCT191 Synchronous n-Stage Counter With Parallel Gated Terminal Count**



NOTE: Illegal states in BCD counters corrected in one count

NOTE: Illegal states in BCD counters corrected in one or two counts

**Figure 3. 'HC190 State Diagram**

**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†**

|  |                |
|--|----------------|
| Supply voltage range, $V_{CC}$ .....   | –0.5 V to 7 V  |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1) .....           | ±20 mA         |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1) .....          | ±20 mA         |
| Continuous output drain current per output, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....          | ±35 mA         |
| Continuous output source or sink current per output, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) ..... | ±25 mA         |
| Continuous current through $V_{CC}$ or GND .....   | ±50 mA         |
| Package thermal impedance, $\theta_{JA}$ (see Note 2): E package .....                     | 67°C/W         |
| M package .....  | 73°C/W         |
| NS package .....   | 64°C/W         |
| PW package .....   | 108°C/W        |
| Storage temperature range, $T_{stg}$ .....   | –65°C to 150°C |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
 2. The package thermal impedance is calculated in accordance with JESD 51-7.

**recommended operating conditions for 'HC190 and 'HC191 (see Note 3)**

|          |                                       | $T_A = 25^\circ\text{C}$ |          | $T_A = -55^\circ\text{C}$<br>TO $125^\circ\text{C}$ |          | $T_A = -40^\circ\text{C}$<br>TO $85^\circ\text{C}$ |          | UNIT |
|----------|---------------------------------------|--------------------------|----------|---|----------|--|----------|------|
|          |                                       | MIN                      | MAX      | MIN   | MAX      | MIN  | MAX      |      |
| $V_{CC}$ | Supply voltage                        | 2                        | 6        | 2   | 6        | 2  | 6        | V    |
| $V_{IH}$ | High-level input voltage              | $V_{CC} = 2\text{ V}$    |          | 1.5   | 1.5      | 1.5  |          | V    |
|          |                                       | $V_{CC} = 4.5\text{ V}$  |          | 3.15  | 3.15     | 3.15   |          |      |
|          |                                       | $V_{CC} = 6\text{ V}$    |          | 4.2   | 4.2      | 4.2  |          |      |
| $V_{IL}$ | Low-level input voltage               | $V_{CC} = 2\text{ V}$    |          | 0.5   |          | 0.5  |          | V    |
|          |                                       | $V_{CC} = 4.5\text{ V}$  |          | 1.35  |          | 1.35   |          |      |
|          |                                       | $V_{CC} = 6\text{ V}$    |          | 1.8   |          | 1.8  |          |      |
| $V_I$    | Input voltage                         | 0                        | $V_{CC}$ | 0   | $V_{CC}$ | 0  | $V_{CC}$ | V    |
| $V_O$    | Output voltage                        | 0                        | $V_{CC}$ | 0   | $V_{CC}$ | 0  | $V_{CC}$ | V    |
| $t_t$    | Input transition (rise and fall) time | $V_{CC} = 2\text{ V}$    |          | 1000  |          | 1000   |          | ns   |
|          |                                       | $V_{CC} = 4.5\text{ V}$  |          | 500   |          | 500  |          |      |
|          |                                       | $V_{CC} = 6\text{ V}$    |          | 400   |          | 400  |          |      |

NOTE 3: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

**recommended operating conditions for 'HCT191 (see Note 4)**

|          |                                       | $T_A = 25^\circ\text{C}$ |     | $T_A = -55^\circ\text{C}$<br>TO $125^\circ\text{C}$ |     | $T_A = -40^\circ\text{C}$<br>TO $85^\circ\text{C}$ |     | UNIT |
|----------|---------------------------------------|--------------------------|-----|---|-----|--|-----|------|
|          |                                       | MIN                      | MAX | MIN   | MAX | MIN  | MAX |      |
| $V_{CC}$ | Supply voltage                        | 4.5                      | 5.5 | 4.5   | 5.5 | 4.5  | 5.5 | V    |
| $V_{IH}$ | High-level input voltage              | 2                        |     | 2   |     | 2  |     | V    |
| $V_{IL}$ | Low-level input voltage               | 0.8                      |     | 0.8   |     | 0.8  |     | V    |
| $V_I$    | Input voltage                         | $V_{CC}$                 |     | $V_{CC}$  |     | $V_{CC}$   |     | V    |
| $V_O$    | Output voltage                        | $V_{CC}$                 |     | $V_{CC}$  |     | $V_{CC}$   |     | V    |
| $t_t$    | Input transition (rise and fall) time | 500                      |     | 500   |     | 500  |     | ns   |

NOTE 4: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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**'HC190, 'HC191**

**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

| PARAMETER       | TEST CONDITIONS   |                           | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     | T <sub>A</sub> = -55°C TO 125°C |     | T <sub>A</sub> = -40°C TO 85°C |     | UNIT |
|-----------------|---|---------------------------|-----------------|-----------------------|-----|---------------------------------|-----|--------------------------------|-----|------|
|                 |   |                           |                 | MIN                   | MAX | MIN                             | MAX | MIN                            | MAX |      |
| V <sub>OH</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>       | I <sub>OH</sub> = -20 μA  | 2 V             | 1.9                   | 1.9 | 1.9                             |     |                                | V   |      |
|                 |   |                           | 4.5 V           | 4.4                   | 4.4 | 4.4                             |     |                                |     |      |
|                 |   |                           | 6 V             | 5.9                   | 5.9 | 5.9                             |     |                                |     |      |
|                 |   | I <sub>OH</sub> = -4 mA   | 4.5 V           | 3.98                  | 3.7 | 3.84                            |     |                                |     |      |
|                 |   | I <sub>OH</sub> = -5.2 mA | 6 V             | 5.48                  | 5.2 | 5.34                            |     |                                |     |      |
| V <sub>OL</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>       | I <sub>OL</sub> = 20 μA   | 2 V             | 0.1                   | 0.1 | 0.1                             |     |                                | V   |      |
|                 |   |                           | 4.5 V           | 0.1                   | 0.1 | 0.1                             |     |                                |     |      |
|                 |   |                           | 6 V             | 0.1                   | 0.1 | 0.1                             |     |                                |     |      |
|                 |   | I <sub>OL</sub> = 4 mA    | 4.5 V           | 0.26                  | 0.4 | 0.33                            |     |                                |     |      |
|                 |   | I <sub>OL</sub> = 5.2 mA  | 6 V             | 0.26                  | 0.4 | 0.33                            |     |                                |     |      |
| I <sub>I</sub>  | V <sub>I</sub> = V <sub>CC</sub> or 0                     |                           | 6 V             | ±0.1                  |     | ±1                              |     | ±1                             |     | μA   |
| I <sub>CC</sub> | V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0 |                           | 6 V             | 8                     |     | 160                             |     | 80                             |     | μA   |
| C <sub>i</sub>  |   |                           |                 | 10                    |     | 10                              |     | 10                             |     | pF   |

**'HCT191**

**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

| PARAMETER          | TEST CONDITIONS  |                          | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |      | T <sub>A</sub> = -55°C TO 125°C |     | T <sub>A</sub> = -40°C TO 85°C |     | UNIT |
|--------------------|--|--------------------------|-----------------|-----------------------|-----|------|---------------------------------|-----|--------------------------------|-----|------|
|                    |  |                          |                 | MIN                   | TYP | MAX  | MIN                             | MAX | MIN                            | MAX |      |
| V <sub>OH</sub>    | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                        | I <sub>OH</sub> = -20 μA | 4.5 V           | 4.4                   |     |      | 4.4                             |     | 4.4                            | V   |      |
|                    |  | I <sub>OH</sub> = -4 mA  |                 | 3.98                  |     |      | 3.7                             |     | 3.84                           |     |      |
| V <sub>OL</sub>    | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                        | I <sub>OL</sub> = 20 μA  | 4.5 V           |                       |     | 0.1  |                                 | 0.1 |                                | V   |      |
|                    |  | I <sub>OL</sub> = 4 mA   |                 |                       |     | 0.26 |                                 | 0.4 |                                |     | 0.33 |
| I <sub>I</sub>     | V <sub>I</sub> = V <sub>CC</sub> to GND                                    |                          | 5.5 V           |                       |     | ±0.1 |                                 | ±1  |                                | ±1  | μA   |
| I <sub>CC</sub>    | V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0                  |                          | 5.5 V           |                       |     | 8    |                                 | 160 |                                | 80  | μA   |
| ΔI <sub>CC</sub> † | One input at V <sub>CC</sub> - 2.1 V, Other inputs at 0 or V <sub>CC</sub> |                          | 4.5 V to 5.5 V  |                       | 100 | 360  |                                 | 490 |                                | 450 | μA   |
| C <sub>i</sub>     |  |                          |                 |                       |     | 10   |                                 | 10  |                                | 10  | pF   |

† Additional quiescent supply current per input pin, TTL inputs high, 1 unit load

**HCT INPUT LOADING TABLE**

| INPUTS | UNIT LOADS |
|--------|------------|
| A-D    | 0.4        |
| CLK    | 1.5        |
| LOAD   | 1.5        |
| D/Ū    | 1.2        |
| CTEN   | 1.5        |

Unit load is ΔI<sub>CC</sub> limit specified in electrical characteristics table, (e.g., 360 μA max at 25°C).



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'HC190, 'HC191 timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 4)

|                    |   | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     | T <sub>A</sub> = -55°C TO 125°C |     | T <sub>A</sub> = -40°C TO 85°C |     | UNIT |
|--------------------|---|-----------------|-----------------------|-----|---------------------------------|-----|--------------------------------|-----|------|
|                    |   |                 | MIN                   | MAX | MIN                             | MAX | MIN                            | MAX |      |
| f <sub>clock</sub> | Clock frequency†  | 2 V             | 6                     |     | 4                               |     | 5                              |     | MHz  |
|                    |   | 4.5 V           | 30                    |     | 20                              |     | 25                             |     |      |
|                    |   | 6 V             | 35                    |     | 23                              |     | 29                             |     |      |
| t <sub>w</sub>     | $\overline{\text{LOAD}}$ low                            | 2 V             | 80                    |     | 120                             |     | 100                            |     | ns   |
|                    |   | 4.5 V           | 16                    |     | 24                              |     | 20                             |     |      |
|                    |   | 6 V             | 14                    |     | 20                              |     | 17                             |     |      |
|                    | CLK high or low   | 2 V             | 100                   |     | 150                             |     | 125                            |     |      |
|                    |   | 4.5 V           | 20                    |     | 30                              |     | 25                             |     |      |
|                    |   | 6 V             | 17                    |     | 26                              |     | 21                             |     |      |
| t <sub>su</sub>    | Data before $\overline{\text{LOAD}}\uparrow$            | 2 V             | 60                    |     | 90                              |     | 75                             |     | ns   |
|                    |   | 4.5 V           | 12                    |     | 18                              |     | 15                             |     |      |
|                    |   | 6 V             | 10                    |     | 15                              |     | 13                             |     |      |
|                    | $\overline{\text{CTEN}}$ before CLK $\uparrow$          | 2 V             | 60                    |     | 90                              |     | 75                             |     |      |
|                    |   | 4.5 V           | 12                    |     | 18                              |     | 15                             |     |      |
|                    |   | 6 V             | 10                    |     | 15                              |     | 13                             |     |      |
|                    | D/ $\overline{\text{U}}$ before CLK $\uparrow$          | 2 V             | 90                    |     | 135                             |     | 115                            |     |      |
|                    |   | 4.5 V           | 18                    |     | 27                              |     | 23                             |     |      |
|                    |   | 6 V             | 15                    |     | 23                              |     | 20                             |     |      |
| t <sub>h</sub>     | Data before $\overline{\text{LOAD}}\uparrow$            | 2 V             | 2                     |     | 2                               |     | 2                              |     | ns   |
|                    |   | 4.5 V           | 2                     |     | 2                               |     | 2                              |     |      |
|                    |   | 6 V             | 2                     |     | 2                               |     | 2                              |     |      |
|                    | $\overline{\text{CTEN}}$ before CLK $\uparrow$          | 2 V             | 2                     |     | 2                               |     | 2                              |     |      |
|                    |   | 4.5 V           | 2                     |     | 2                               |     | 2                              |     |      |
|                    |   | 6 V             | 2                     |     | 2                               |     | 2                              |     |      |
|                    | D/ $\overline{\text{U}}$ before CLK $\uparrow$          | 2 V             | 0                     |     | 0                               |     | 0                              |     |      |
|                    |   | 4.5 V           | 0                     |     | 0                               |     | 0                              |     |      |
|                    |   | 6 V             | 0                     |     | 0                               |     | 0                              |     |      |
| t <sub>rec</sub>   | $\overline{\text{LOAD}}$ inactive before CLK $\uparrow$ | 2 V             | 60                    |     | 90                              |     | 75                             |     | ns   |
|                    |   | 4.5 V           | 12                    |     | 18                              |     | 15                             |     |      |
|                    |   | 6 V             | 10                    |     | 15                              |     | 13                             |     |      |

† Applies to noncascaded operation only. With cascaded counters, clock-to-terminal count propagation delays, CTEN-to-clock setup times, and CTEN-to-clock hold times determine maximum clock frequency. For example, with these HC devices:

$$f_{\text{max}}(\text{CLK}) = \frac{1}{\text{CLK-to-MAX/MIN propagation delay} + \overline{\text{CTEN-to-CLK setup time}} + \overline{\text{CTEN-to-CLK hold time}}} = \frac{1}{42 + 12 + 2} \approx 18 \text{ MHz}$$



**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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'HC190, 'HC191

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 4)

| PARAMETER        | FROM (INPUT)             | TO (OUTPUT)             | LOAD CAPACITANCE       | V <sub>CC</sub> | T <sub>A</sub> = 25°C  |       |     | T <sub>A</sub> = -55°C TO 125°C |     | T <sub>A</sub> = -40°C TO 85°C |     | UNIT |    |    |
|------------------|--------------------------|-------------------------|------------------------|-----------------|------------------------|-------|-----|---------------------------------|-----|--------------------------------|-----|------|----|----|
|                  |                          |                         |                        |                 | MIN                    | TYP   | MAX | MIN                             | MAX | MIN                            | MAX |      |    |    |
| f <sub>max</sub> |                          |                         |                        | 2 V             | 6                      |       |     | 4                               |     | 5                              | MHz |      |    |    |
|                  |                          |                         |                        | 4.5 V           | 30                     |       |     | 20                              |     | 25                             |     |      |    |    |
|                  |                          |                         |                        | 6 V             | 35                     |       |     | 23                              |     | 29                             |     |      |    |    |
| t <sub>pd</sub>  | $\overline{\text{LOAD}}$ | Q                       | C <sub>L</sub> = 50 pF | 2 V             |                        | 195   |     | 295                             |     | 245                            | ns  |      |    |    |
|                  |                          |                         |                        | 4.5 V           |                        | 39    |     | 59                              |     | 49                             |     |      |    |    |
|                  |                          |                         |                        | 6 V             |                        | 33    |     | 50                              |     | 42                             |     |      |    |    |
|                  | A, B, C, or D            | Q                       | C <sub>L</sub> = 50 pF | 2 V             |                        | 175   |     | 265                             |     | 220                            |     |      |    |    |
|                  |                          |                         |                        | 4.5 V           |                        | 35    |     | 53                              |     | 44                             |     |      |    |    |
|                  |                          |                         |                        | 6 V             |                        | 30    |     | 45                              |     | 37                             |     |      |    |    |
|                  | CLK                      | Q                       | C <sub>L</sub> = 50 pF | 2 V             |                        | 170   |     | 255                             |     | 215                            |     |      |    |    |
|                  |                          |                         |                        | 4.5 V           |                        | 34    |     | 51                              |     | 43                             |     |      |    |    |
|                  |                          |                         |                        | 6 V             |                        | 29    |     | 43                              |     | 37                             |     |      |    |    |
|                  | CLK                      | $\overline{\text{RCO}}$ | C <sub>L</sub> = 50 pF | 2 V             |                        | 125   |     | 190                             |     | 155                            |     |      |    |    |
|                  |                          |                         |                        | 4.5 V           |                        | 25    |     | 38                              |     | 31                             |     |      |    |    |
|                  |                          |                         |                        | 6 V             |                        | 21    |     | 32                              |     | 26                             |     |      |    |    |
|                  | CLK                      | MAX/MIN                 | C <sub>L</sub> = 50 pF | 2 V             |                        | 210   |     | 315                             |     | 265                            |     |      |    |    |
|                  |                          |                         |                        | 4.5 V           |                        | 42    |     | 63                              |     | 53                             |     |      |    |    |
|                  |                          |                         |                        | 6 V             |                        | 36    |     | 54                              |     | 45                             |     |      |    |    |
|                  | D/ $\overline{\text{U}}$ | $\overline{\text{RCO}}$ | C <sub>L</sub> = 50 pF | 2 V             |                        | 150   |     | 225                             |     | 190                            |     |      |    |    |
|                  |                          |                         |                        | 4.5 V           |                        | 30    |     | 45                              |     | 38                             |     |      |    |    |
|                  |                          |                         |                        | 6 V             |                        | 26    |     | 38                              |     | 33                             |     |      |    |    |
|                  | D/ $\overline{\text{U}}$ | MAX/MIN                 | C <sub>L</sub> = 50 pF | 2 V             |                        | 165   |     | 250                             |     | 205                            |     |      |    |    |
|                  |                          |                         |                        | 4.5 V           |                        | 33    |     | 50                              |     | 41                             |     |      |    |    |
|                  |                          |                         |                        | 6 V             |                        | 28    |     | 43                              |     | 35                             |     |      |    |    |
|                  | $\overline{\text{CTEN}}$ | $\overline{\text{RCO}}$ | C <sub>L</sub> = 50 pF | 2 V             |                        | 125   |     | 190                             |     | 155                            |     |      |    |    |
|                  |                          |                         |                        | 4.5 V           |                        | 25    |     | 38                              |     | 31                             |     |      |    |    |
|                  |                          |                         |                        | 6 V             |                        | 21    |     | 32                              |     | 26                             |     |      |    |    |
|                  | C <sub>L</sub> = 15 pF   | 5 V                     | 10                     |                 |                        |       |     |                                 |     |                                |     |      |    |    |
|                  |                          |                         |                        | Any             | C <sub>L</sub> = 50 pF | 2 V   |     | 75                              |     | 110                            |     |      | 95 | ns |
|                  |                          |                         |                        |                 |                        | 4.5 V |     | 15                              |     | 22                             |     |      | 19 |    |
|                  | 6 V                      |                         | 13                     |                 |                        |       | 19  |                                 | 16  |                                |     |      |    |    |



**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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**'HCT191**

timing requirements over recommended operating free-air temperature range  $V_{CC} = 4.5\text{ V}$  (unless otherwise noted) (see Figure 5)

|                    |                 | $T_A = 25^\circ\text{C}$                                      |     | $T_A = -55^\circ\text{C}$<br>TO $125^\circ\text{C}$ |     | $T_A = -40^\circ\text{C}$<br>TO $85^\circ\text{C}$ |     | UNIT |
|--------------------|-----------------|---|-----|---|-----|--|-----|------|
|                    |                 | MIN   | MAX | MIN   | MAX | MIN  | MAX |      |
| $f_{\text{clock}}$ | Clock frequency | 30  |     | 20  |     | 25   |     | MHz  |
| $t_w$              | Pulse duration  | $\overline{\text{LOAD}}$ low                                  | 16  | 24  | 20  |  |     | ns   |
|                    |                 | CLK high or low   | 20  | 30  | 25  |  |     |      |
| $t_{\text{su}}$    | Setup time      | Data before $\overline{\text{LOAD}}\uparrow$                  | 12  | 18  | 15  |  |     | ns   |
|                    |                 | $\overline{\text{CTEN}}$ before $\text{CLK}\uparrow$          | 12  | 18  | 15  |  |     |      |
|                    |                 | $\text{D}/\overline{\text{U}}$ before $\text{CLK}\uparrow$    | 18  | 27  | 23  |  |     |      |
| $t_h$              | Hold time       | Data before $\overline{\text{LOAD}}\uparrow$                  | 2   | 2   | 2   |  |     | ns   |
|                    |                 | $\overline{\text{CTEN}}$ before $\text{CLK}\uparrow$          | 2   | 2   | 2   |  |     |      |
|                    |                 | $\text{D}/\overline{\text{U}}$ before $\text{CLK}\uparrow$    | 0   | 0   | 0   |  |     |      |
| $t_{\text{rec}}$   | Recovery time   | $\overline{\text{LOAD}}$ inactive before $\text{CLK}\uparrow$ | 12  | 18  | 15  |  |     | ns   |

**'HCT191**

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 5)

| PARAMETER                | FROM (INPUT)                   | TO (OUTPUT)             | LOAD CAPACITANCE     | $V_{CC}$ | $T_A = 25^\circ\text{C}$ |     |     | $T_A = -55^\circ\text{C}$<br>TO $125^\circ\text{C}$ |     | $T_A = -40^\circ\text{C}$<br>TO $85^\circ\text{C}$ |     | UNIT |
|--------------------------|--------------------------------|-------------------------|----------------------|----------|--------------------------|-----|-----|---|-----|--|-----|------|
|                          |                                |                         |                      |          | MIN                      | TYP | MAX | MIN   | MAX | MIN  | MAX |      |
| $f_{\text{max}}$         |                                |                         |                      | 4.5 V    | 30                       |     |     | 20  |     | 25   |     | MHz  |
| $t_{\text{pd}}$          | $\overline{\text{LOAD}}$       | Q                       | $C_L = 50\text{ pF}$ | 4.5 V    |                          |     | 40  |   | 60  |  | 50  | ns   |
|                          |                                |                         | $C_L = 15\text{ pF}$ | 5 V      |                          | 17  |     |   |     |  |     |      |
|                          | A, B, C, or D                  | Q                       | $C_L = 50\text{ pF}$ | 4.5 V    |                          |     | 38  |   | 57  |  | 48  |      |
|                          |                                |                         | $C_L = 15\text{ pF}$ | 5 V      |                          | 16  |     |   |     |  |     |      |
|                          | CLK                            | $\overline{\text{RCO}}$ | $C_L = 50\text{ pF}$ | 4.5 V    |                          |     | 35  |   | 53  |  | 44  |      |
|                          |                                |                         | $C_L = 15\text{ pF}$ | 5 V      |                          | 14  |     |   |     |  |     |      |
|                          | CLK                            | Q                       | $C_L = 50\text{ pF}$ | 4.5 V    |                          |     | 27  |   | 41  |  | 34  |      |
|                          |                                |                         | $C_L = 15\text{ pF}$ | 5 V      |                          | 11  |     |   |     |  |     |      |
|                          | CLK                            | MAX/MIN                 | $C_L = 50\text{ pF}$ | 4.5 V    |                          |     | 42  |   | 63  |  | 53  |      |
|                          |                                |                         | $C_L = 15\text{ pF}$ | 5 V      |                          | 18  |     |   |     |  |     |      |
|                          | $\text{D}/\overline{\text{U}}$ | $\overline{\text{RCO}}$ | $C_L = 50\text{ pF}$ | 4.5 V    |                          |     | 30  |   | 45  |  | 38  |      |
|                          |                                |                         | $C_L = 15\text{ pF}$ | 5 V      |                          | 12  |     |   |     |  |     |      |
|                          | $\text{D}/\overline{\text{U}}$ | MAX/MIN                 | $C_L = 50\text{ pF}$ | 4.5 V    |                          |     | 38  |   | 57  |  | 48  |      |
|                          |                                |                         | $C_L = 15\text{ pF}$ | 5 V      |                          | 16  |     |   |     |  |     |      |
| $\overline{\text{CTEN}}$ | $\overline{\text{RCO}}$        | $C_L = 50\text{ pF}$    | 4.5 V                |          |                          | 27  |     | 41  |     | 34   |     |      |
|                          |                                | $C_L = 15\text{ pF}$    | 5 V                  |          | 11                       |     |     |   |     |  |     |      |
| $t_t$                    |                                | Any                     | $C_L = 50\text{ pF}$ | 4.5 V    |                          |     | 15  |   | 22  |  | 19  | ns   |



**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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operating characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER                              |         | TYP | UNIT |
|--|---------|-----|------|
| $C_{pd}$ Power dissipation capacitance | 'HC190  | 59  | pF   |
|  | 'HC191  | 55  |      |
|  | 'HCT191 | 68  |      |



**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

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**PARAMETER MEASUREMENT INFORMATION – 'HC190, 'HC191**



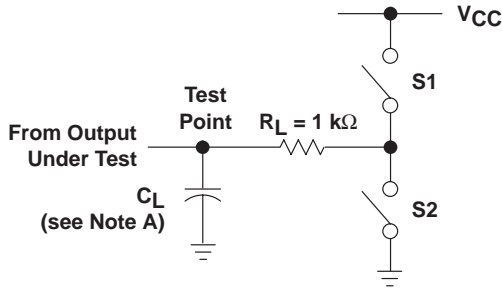
- NOTES: A.  $C_L$  includes probe and test-fixture capacitance.  
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.  
 C. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r = 6\text{ ns}$ ,  $t_f = 6\text{ ns}$ .  
 D. For clock inputs,  $f_{max}$  is measured with the input duty cycle at 50%.  
 E. The outputs are measured one at a time with one input transition per measurement.  
 F.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .  
 G.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .  
 H.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

**Figure 4. Load Circuit and Voltage Waveforms**

**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

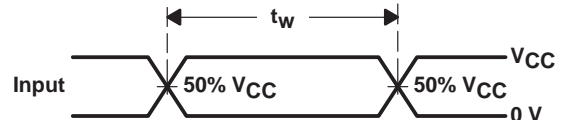
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**PARAMETER MEASUREMENT INFORMATION – 'HCT191**

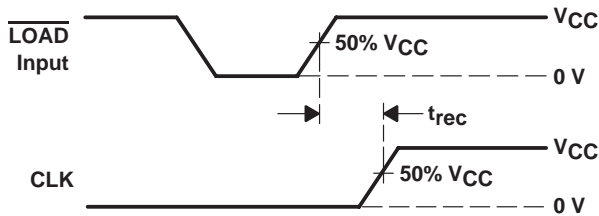


**LOAD CIRCUIT**

| PARAMETER         | S1        | S2     |        |
|-------------------|-----------|--------|--------|
| $t_{en}$          | $t_{PZH}$ | Open   | Closed |
|                   | $t_{PZL}$ | Closed | Open   |
| $t_{dis}$         | $t_{PHZ}$ | Open   | Closed |
|                   | $t_{PLZ}$ | Closed | Open   |
| $t_{pd}$ or $t_t$ | Open      | Open   |        |



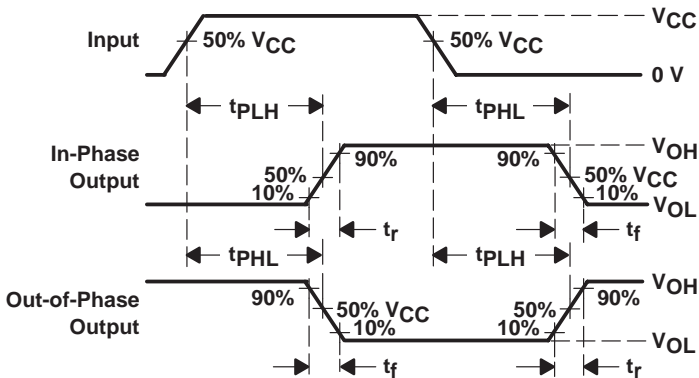
**VOLTAGE WAVEFORMS PULSE DURATION**



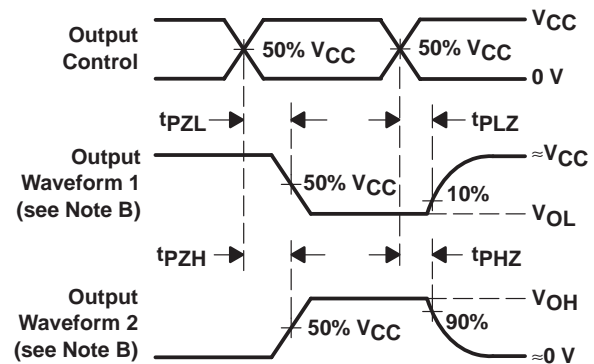
**VOLTAGE WAVEFORMS RECOVERY TIME**



**VOLTAGE WAVEFORMS SETUP AND HOLD AND INPUT RISE AND FALL TIMES**



**VOLTAGE WAVEFORMS PROPAGATION DELAY AND OUTPUT TRANSITION TIMES**



**VOLTAGE WAVEFORMS OUTPUT ENABLE AND DISABLE TIMES**

- NOTES: A.  $C_L$  includes probe and test-fixture capacitance.  
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.  
 C. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 6$  ns,  $t_f = 6$  ns.  
 D. For clock inputs,  $f_{max}$  is measured with the input duty cycle at 50%.  
 E. The outputs are measured one at a time with one input transition per measurement.  
 F.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .  
 G.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .  
 H.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

**Figure 5. Load Circuit and Voltage Waveforms**



**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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 5962-8867101EA   | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| 5962-8994601EA   | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| CD54HC190F3A     | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| CD54HC191F3A     | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| CD54HCT191F3A    | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| CD74HC190E       | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HC190EE4     | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HC190NSR     | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC190NSRE4   | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC190NSRG4   | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC190PW      | ACTIVE                | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC190PWE4    | ACTIVE                | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC190PWG4    | ACTIVE                | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC190PWR     | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC190PWRE4   | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC190PWRG4   | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC190PWT     | ACTIVE                | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC190PWTE4   | ACTIVE                | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC190PWTG4   | ACTIVE                | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC191E       | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HC191EE4     | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HC191M       | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC191M96     | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC191M96E4   | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC191M96G4   | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC191ME4     | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC191MG4     | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

| 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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CD74HC191MT      | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC191MTE4    | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC191MTG4    | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT191E      | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HCT191EE4    | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HCT191M      | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT191ME4    | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT191MG4    | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

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

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

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

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

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

**OBSELETE:** 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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD74HC190NSR | SO           | NS              | 16   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| CD74HC190PWR | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 7.0     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| CD74HC191M96 | 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) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD74HC190NSR | SO           | NS              | 16   | 2000 | 346.0       | 346.0      | 33.0        |
| CD74HC190PWR | TSSOP        | PW              | 16   | 2000 | 346.0       | 346.0      | 29.0        |
| CD74HC191M96 | SOIC         | D               | 16   | 2500 | 333.2       | 345.9      | 28.6        |

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)        |

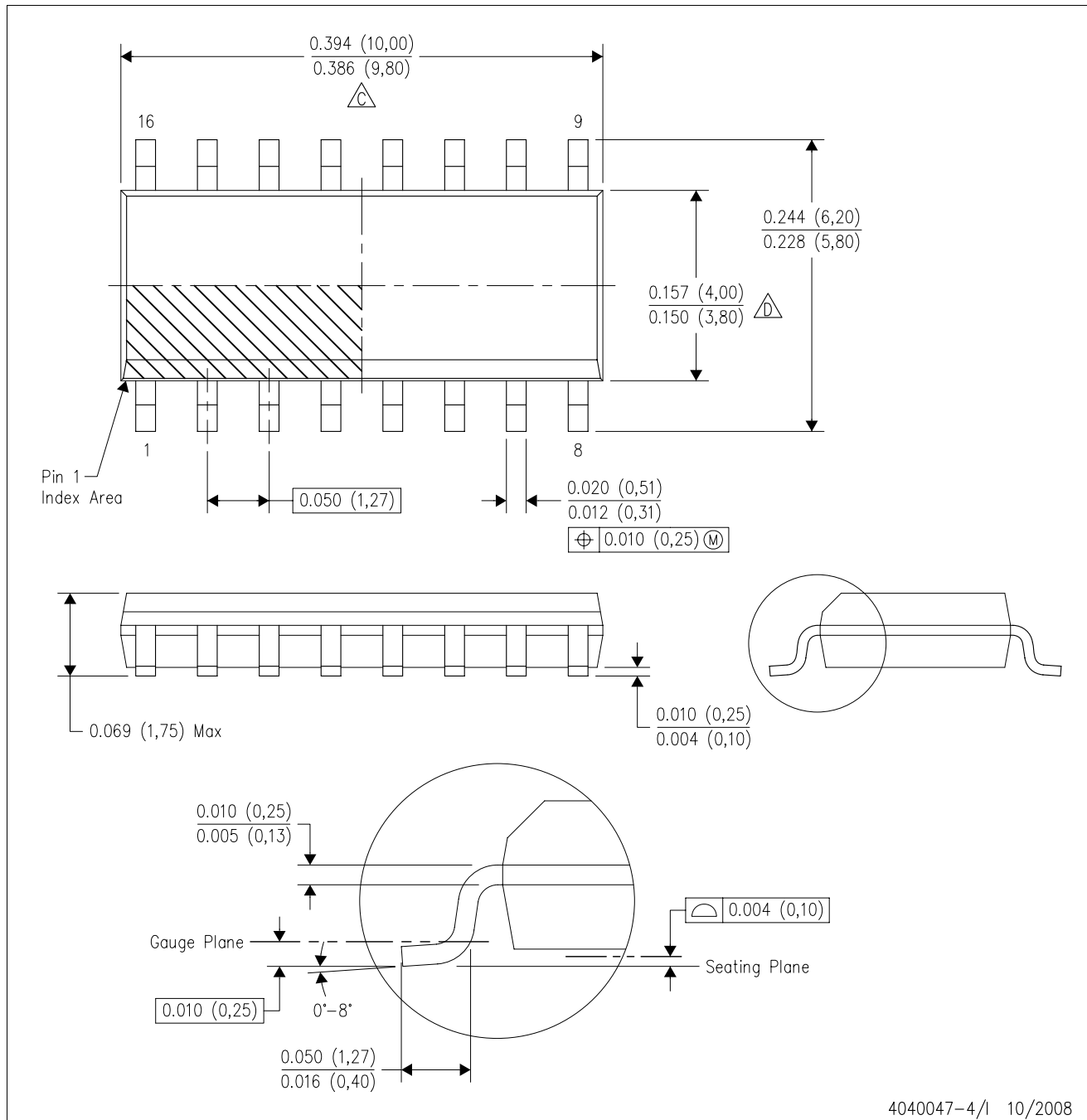


4040083/F 03/03

- 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.

D(R-PDSO-G16)



4209373/A 03/08

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Refer to IPC7351 for alternate board design.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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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