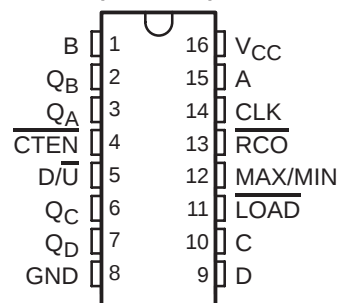


# CD54HC190, CD74HC190 CD54HC191, CD74HC191, CD54HCT191, CD74HCT191 SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

- 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 <sup>†</sup> |              | 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   | CD74HC191M            | HC191M           |
|                                                |                      | Reel of 2500 | CD74HC191M96          |                  |
|                                                |                      | Reel of 250  | CD74HC191MT           |                  |
|                                                |                      | Tube of 40   | CD74HCT191M           | HCT191M          |
|                                                | SOP – NS             | Reel of 2000 | CD74HC190NSR          | HC190M           |
|                                                | TSSOP – PW           | Tube of 90   | CD74HC190PW           | HJ190            |
|                                                |                      | Reel of 2000 | CD74HC190PWR          |                  |
|                                                |                      | Reel of 250  | CD74HC190PWT          |                  |
|                                                | CDIP – F             | Tube of 25   | CD54HC190F3A          | CD54HC190F3A     |
|                                                |                      |              | CD54HC191F3A          | CD54HC191F3A     |
|                                                |                      |              | CD54HCT191F3A         | CD54HCT191F3A    |

<sup>†</sup> 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).



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2003, Texas Instruments Incorporated  
On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

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

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

## 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           |

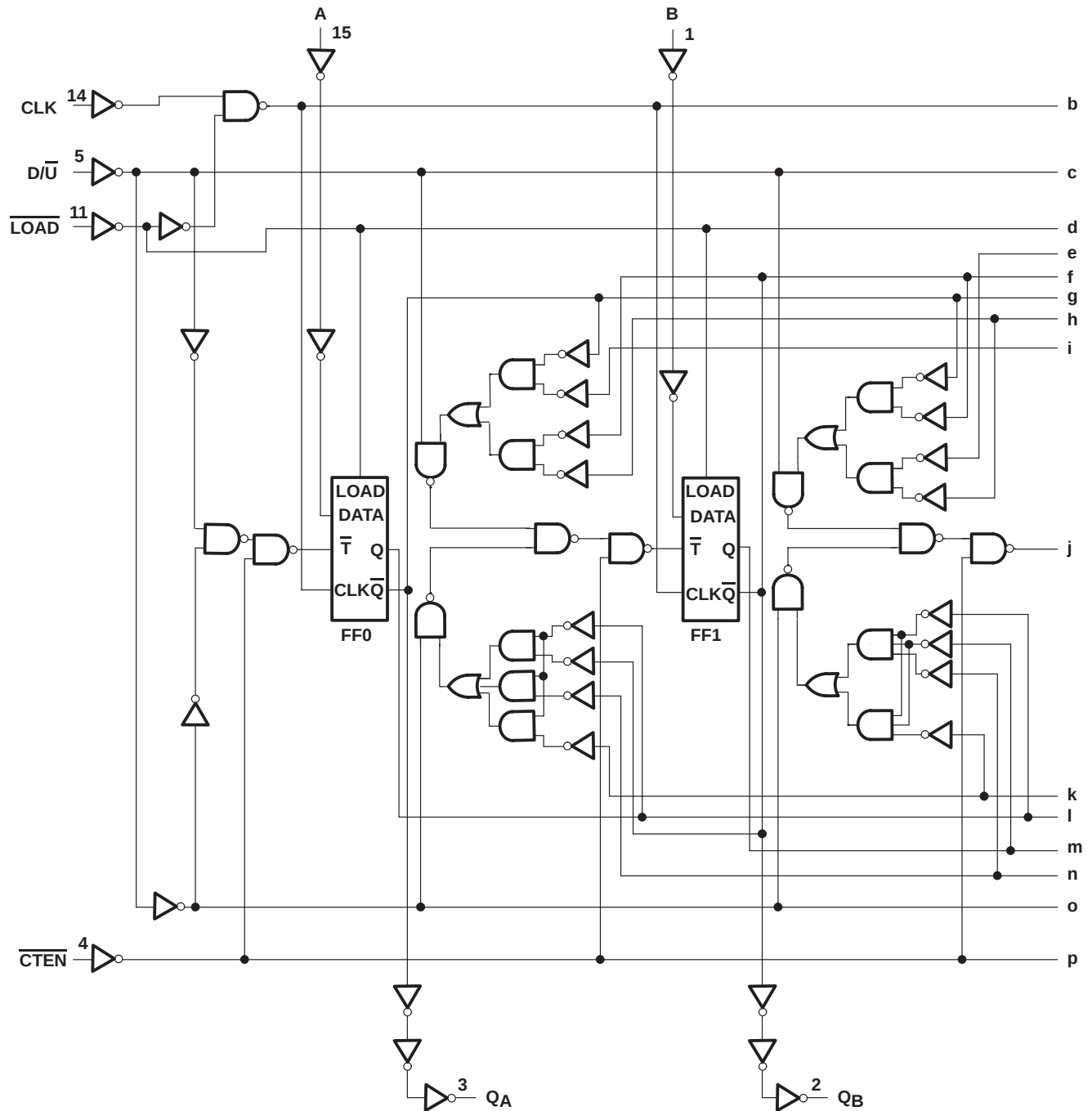
$D/\overline{U}$  or  $\overline{CTEN}$  should be changed only when clock is high.

X = Don't care

 Low-to-high clock transition

**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**  
SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

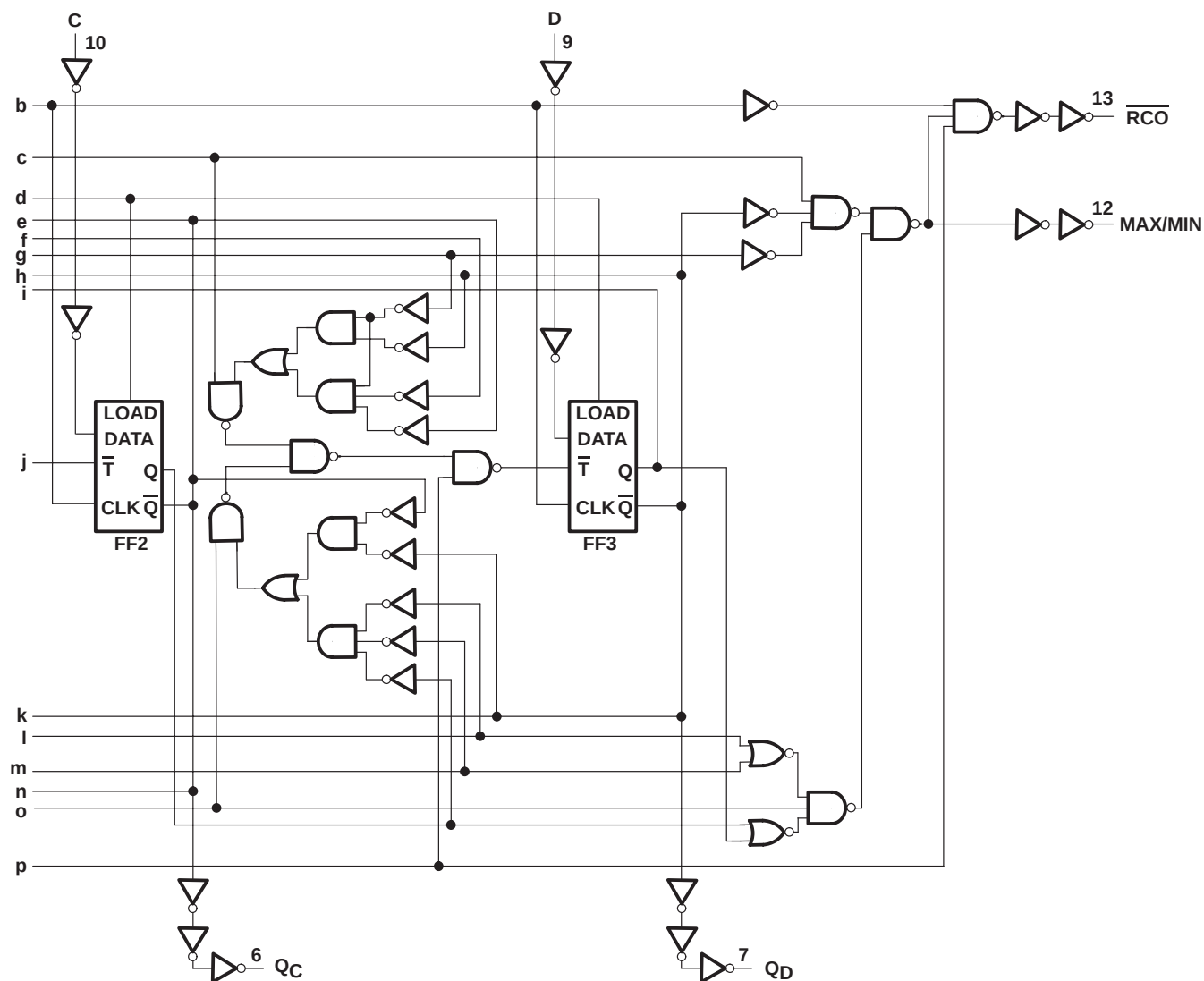
'HC190 logic diagram



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

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

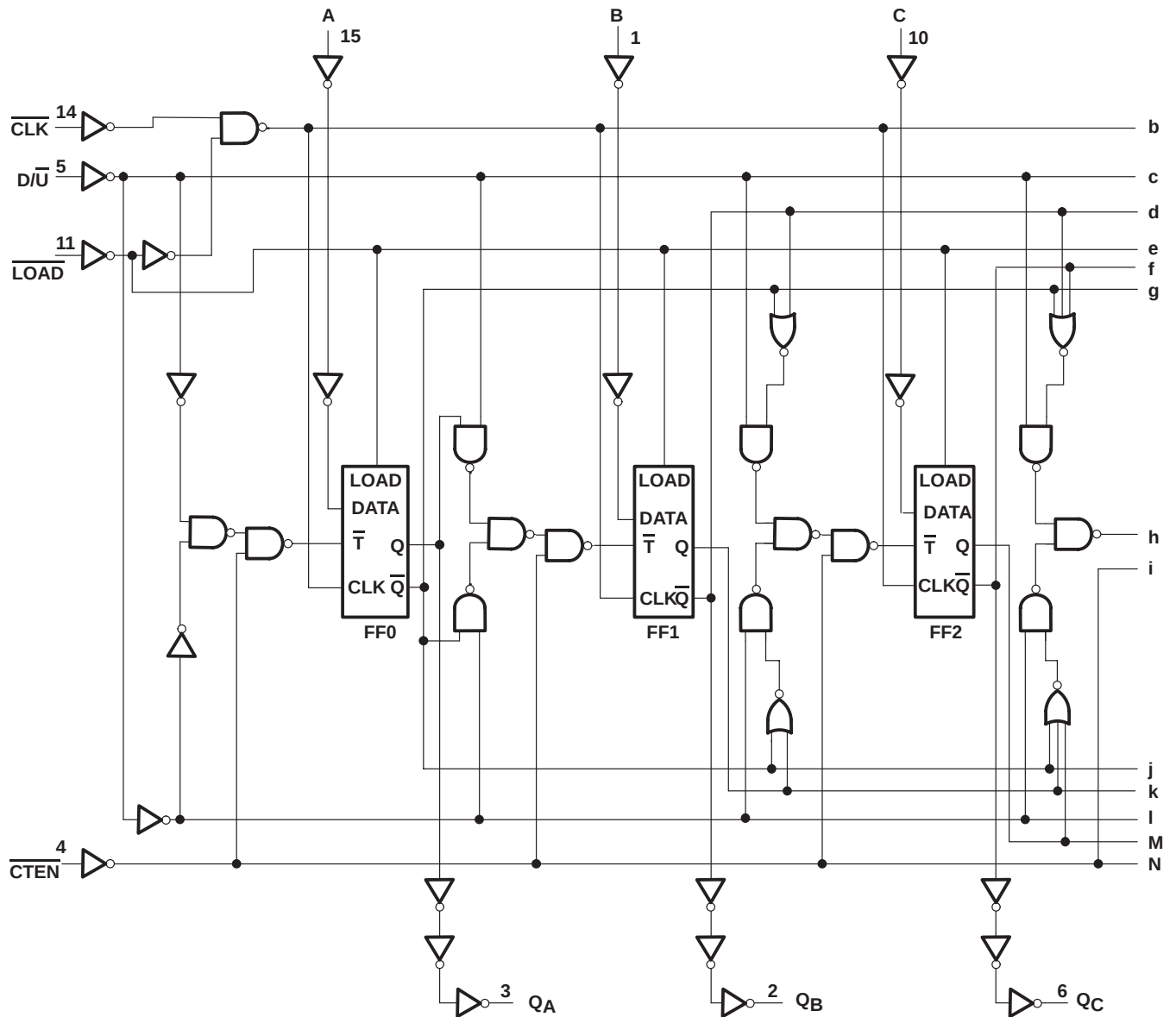
**'HC190 logic diagram (continued)**



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

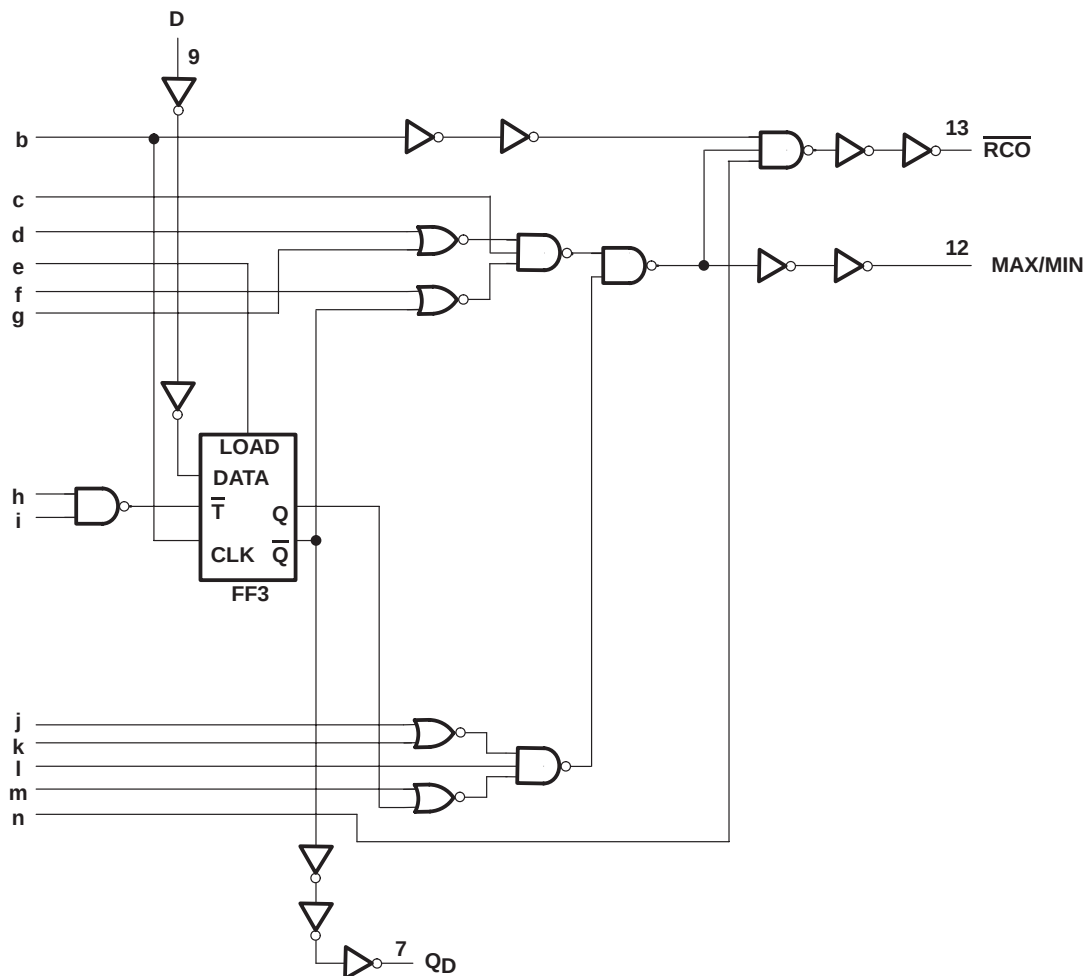
SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

'HC191, 'HCT191 logic diagram

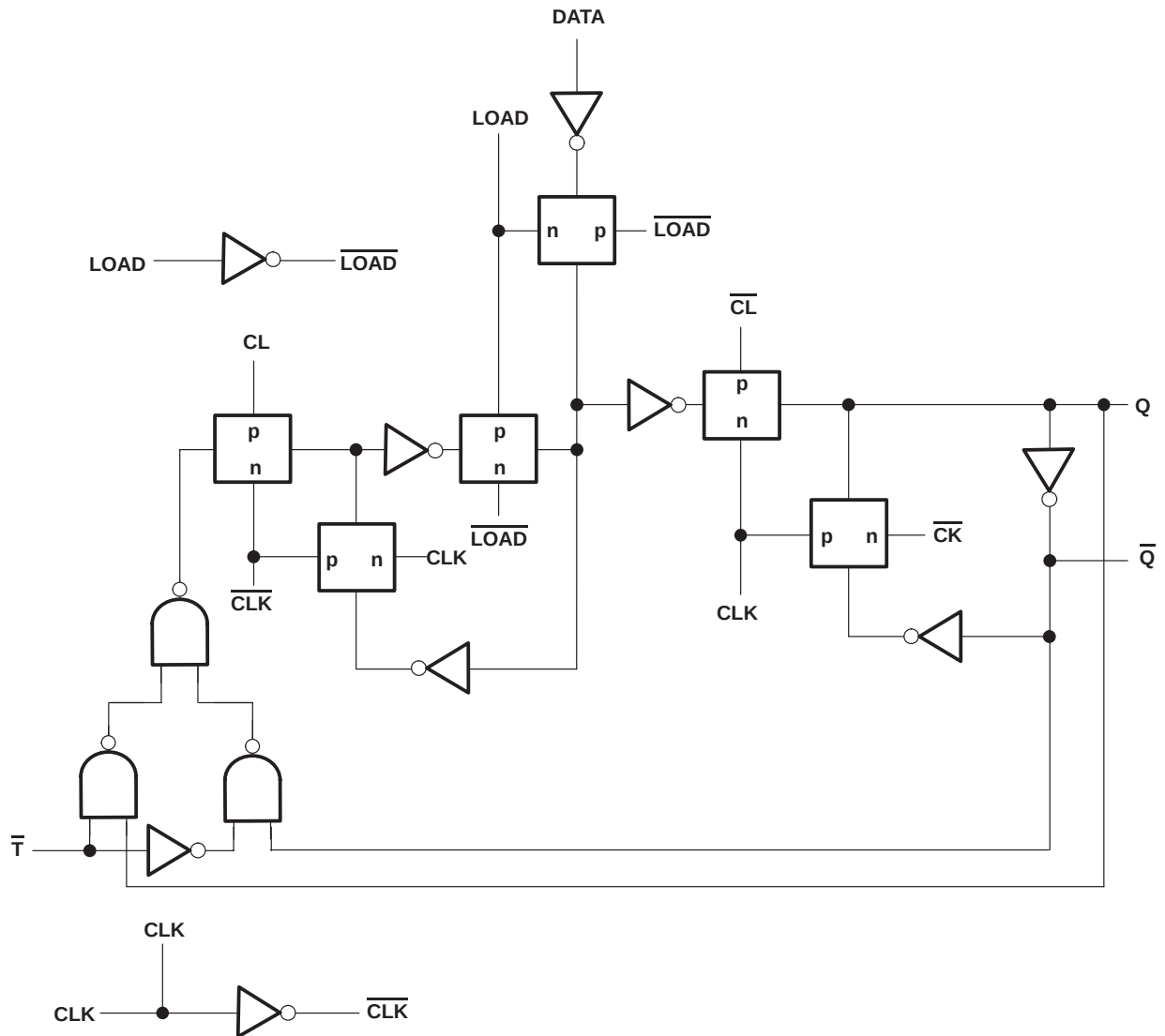


SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

### 'HC191, 'HCT191 logic diagram (continued)



**'HC190 and 'HC191/HCT191 flip-flop**



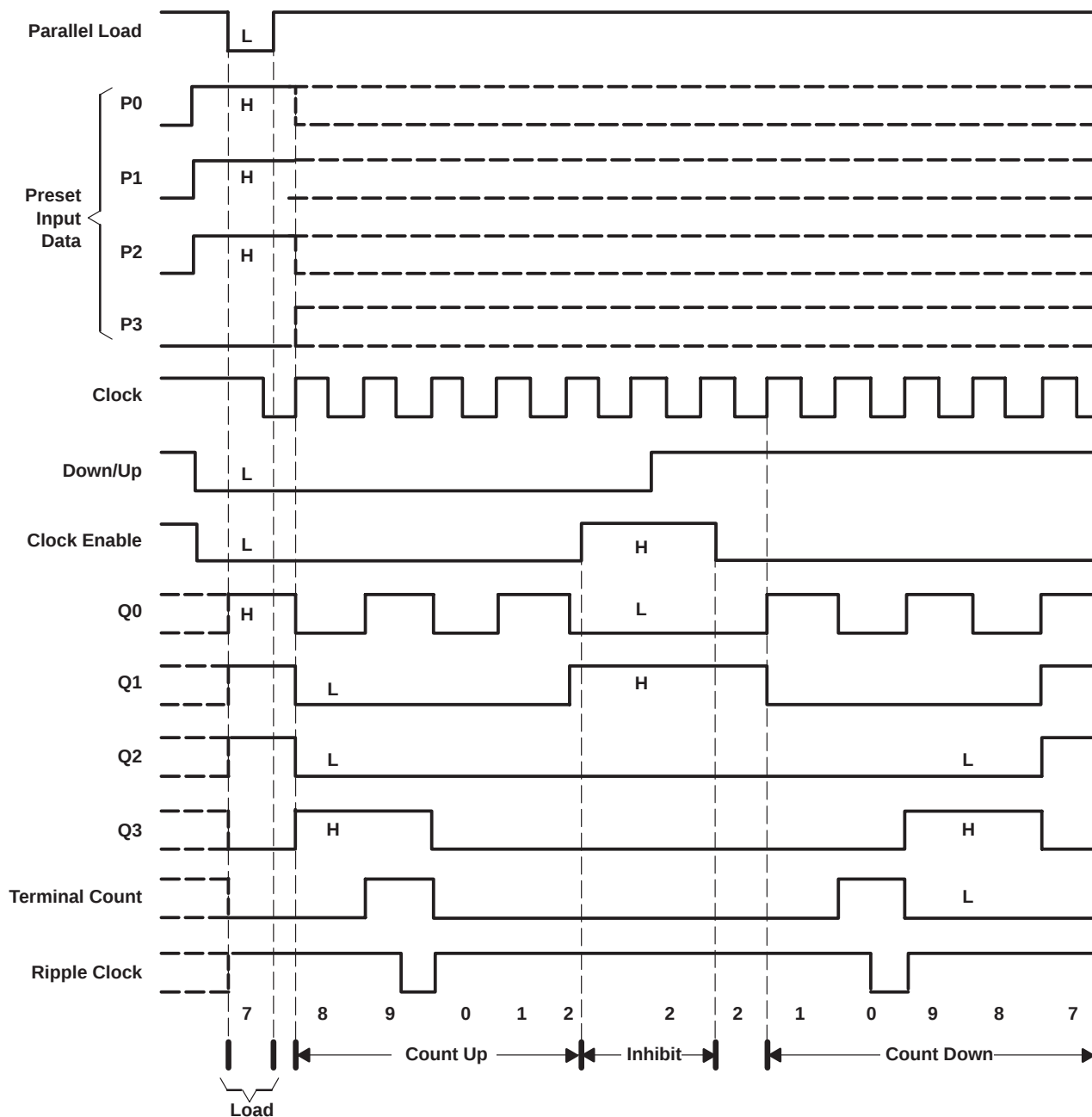
**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

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

The following sequence is illustrated below:

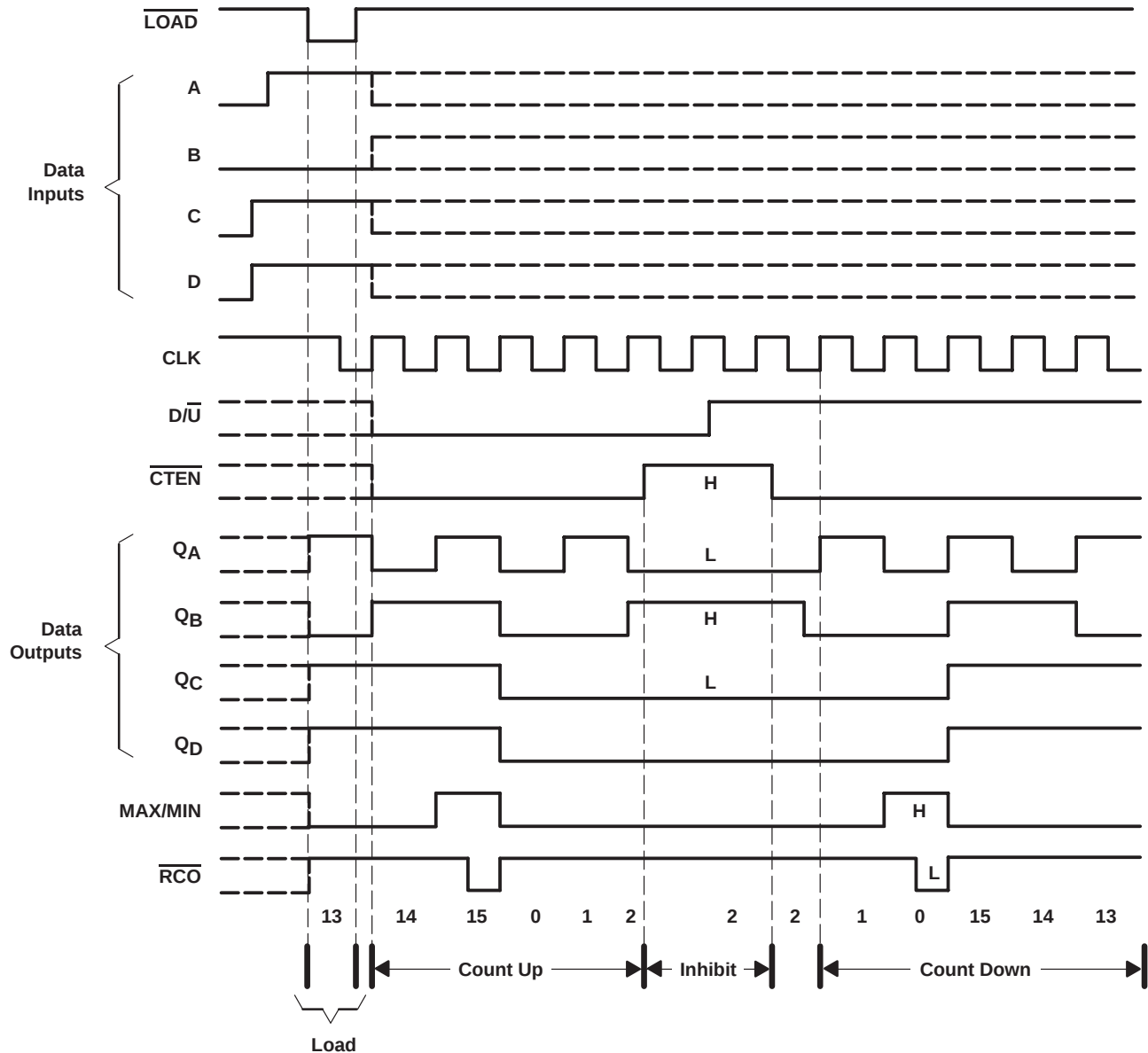
1. Load (preset) to BCD 7
2. Count up to 8, 9 (maximum), 0, 1, and 2
3. Inhibit
4. Count down to 1, 0 (minimum), 9, 8, and 7



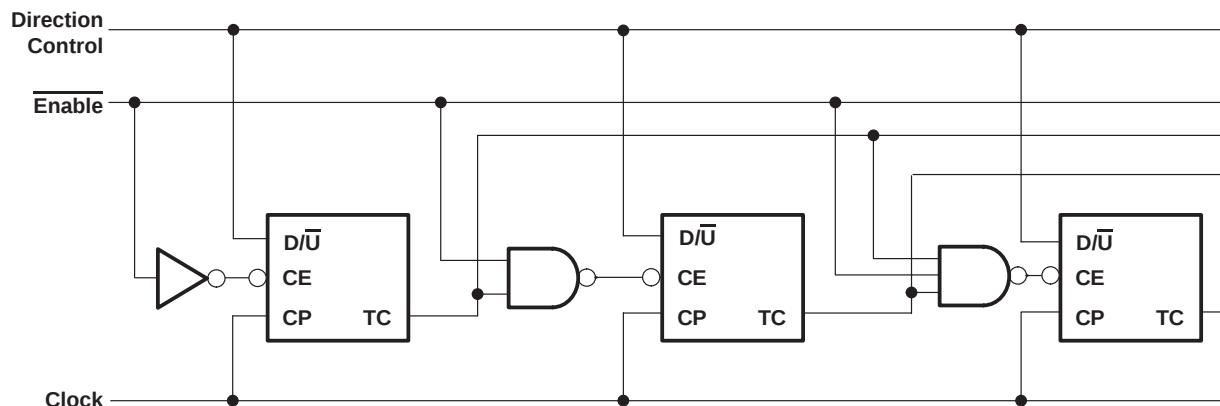
**typical load, count, and inhibit sequence for 'HC191 and 'HCT191**

The following sequence is illustrated below:

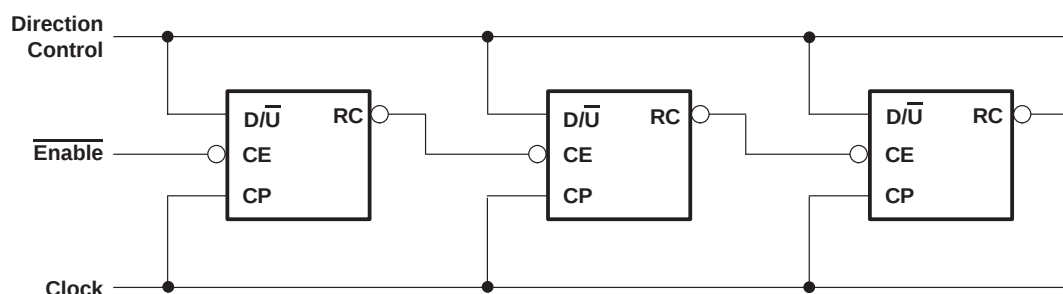
1. Load (preset) to binary 13
2. Count up to 14, 15 (maximum), 0, 1, and 2
3. Inhibit
4. Count down to 1, 0 (minimum), 15, 14, and 13



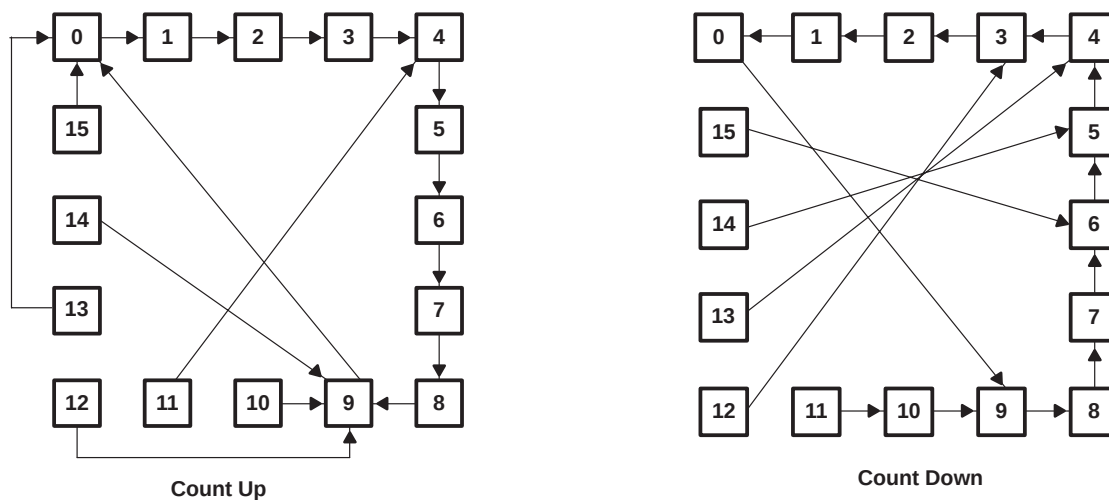
**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**  
 SCHS275E – MARCH 2002 – REVISED OCTOBER 2003



**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**

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

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

|                                                                                      |                |
|--------------------------------------------------------------------------------------|----------------|
| 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 |

<sup>†</sup> 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      |                                                    | 0.5      | V    |
|          |                                       | $V_{CC} = 4.5\text{ V}$ |                          | 1.35     |                                                     | 1.35     |                                                    | 1.35     |      |
|          |                                       | $V_{CC} = 6\text{ V}$   |                          | 1.8      |                                                     | 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     |                                                    | 1000     | ns   |
|          |                                       | $V_{CC} = 4.5\text{ V}$ |                          | 500      |                                                     | 500      |                                                    | 500      |      |
|          |                                       | $V_{CC} = 6\text{ V}$   |                          | 400      |                                                     | 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**

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

**'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 |                                | 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> <sup>†</sup> | 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   |

<sup>†</sup> 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/ $\overline{U}$ | 1.2        |
| $\overline{CTEN}$ | 1.5        |

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



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

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

'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 <sup>†</sup>                            | 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                             |     |      |

<sup>†</sup> 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**

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

'HC190, 'HC191

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

| PARAMETER        | FROM<br>(INPUT)          | TO<br>(OUTPUT)          | LOAD<br>CAPACITANCE    | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |     | T <sub>A</sub> = -55°C<br>TO 125°C |     | T <sub>A</sub> = -40°C<br>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,<br>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             |                       | 16  |     |                                    |     |                                   |     |      |
|                  |                          |                         |                        | 5 V             |                       | 14  |     |                                    |     |                                   |     |      |
|                  |                          |                         |                        | 5 V             |                       | 14  |     |                                    |     |                                   |     |      |
| t <sub>t</sub>   |                          | 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**

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

**'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 CLK $\uparrow$          | 12                       |     | 18                                                  |     | 15                                                 |     |      |
|                    |                 | D/ $\overline{\text{U}}$ before CLK $\uparrow$          | 18                       |     | 27                                                  |     | 23                                                 |     |      |
| $t_h$              | Hold time       | Data before $\overline{\text{LOAD}}\uparrow$            | 2                        |     | 2                                                   |     | 2                                                  |     | ns   |
|                    |                 | $\overline{\text{CTEN}}$ before CLK $\uparrow$          | 2                        |     | 2                                                   |     | 2                                                  |     |      |
|                    |                 | D/ $\overline{\text{U}}$ before CLK $\uparrow$          | 0                        |     | 0                                                   |     | 0                                                  |     |      |
| $t_{\text{rec}}$   | Recovery time   | $\overline{\text{LOAD}}$ inactive before CLK $\uparrow$ | 12                       |     | 18                                                  |     | 15                                                 |     | ns   |

**'HCT191**

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

| PARAMETER        | FROM<br>(INPUT)          | TO<br>(OUTPUT)          | LOAD<br>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,<br>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  |     |                                                     |     |                                                    |     |      |
|                  | 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  |     |                                                     |     |                                                    |     |      |
|                  | 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  |     |                                                     |     |                                                    |     |      |
| $t_t$            |                          | Any                     | $C_L = 50\text{ pF}$ | 4.5 V    |                          |     | 15  |                                                     | 22  |                                                    | 19  | ns   |
|                  |                          |                         | $C_L = 15\text{ pF}$ | 5 V      |                          | 11  |     |                                                     |     |                                                    |     |      |

CD54HC190, CD74HC190  
CD54HC191, CD74HC191, CD54HCT191, CD74HCT191  
SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL  
SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

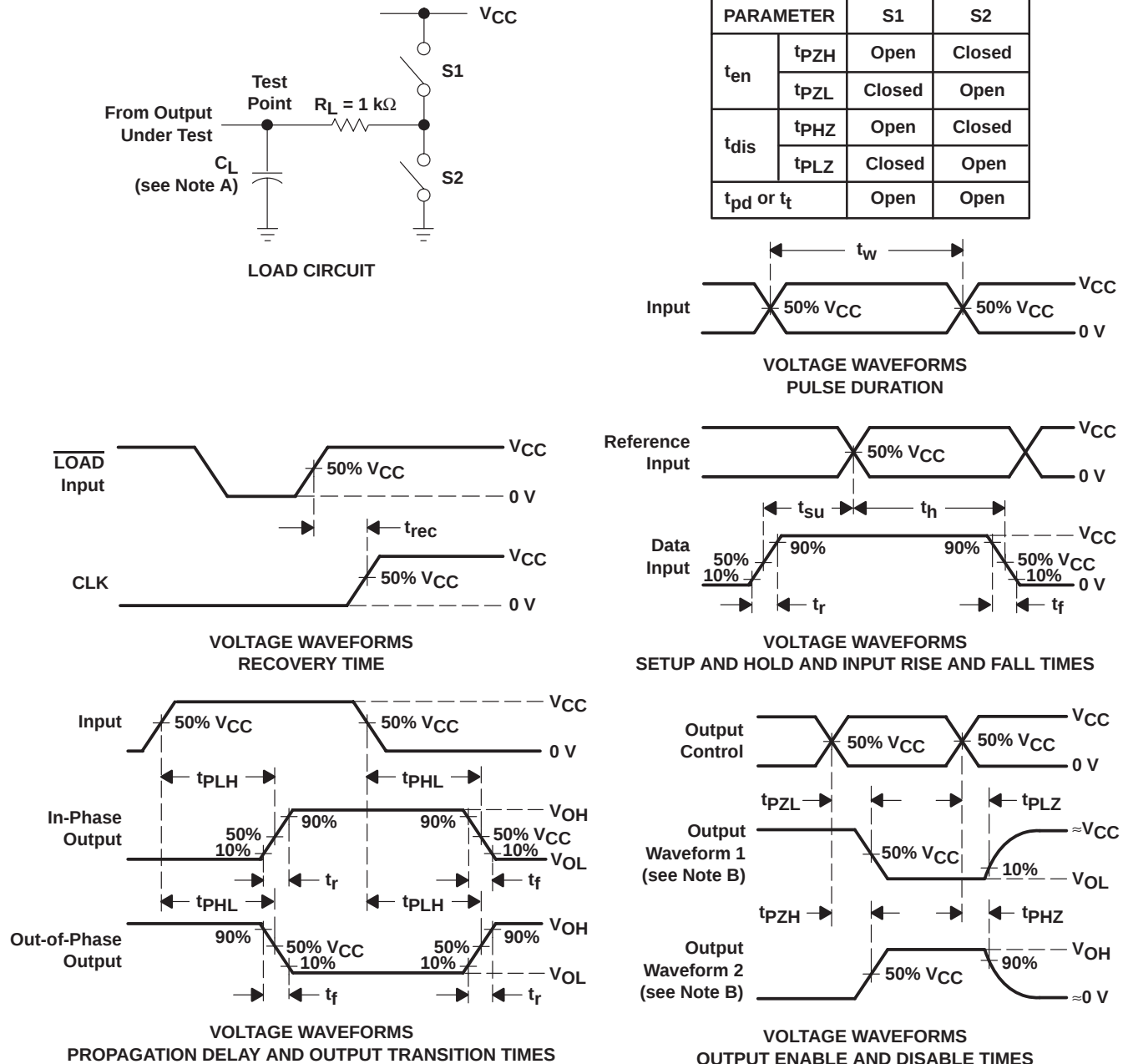
operating characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER                                     |         | TYP | UNIT |
|-----------------------------------------------|---------|-----|------|
| C <sub>pd</sub> 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**

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

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



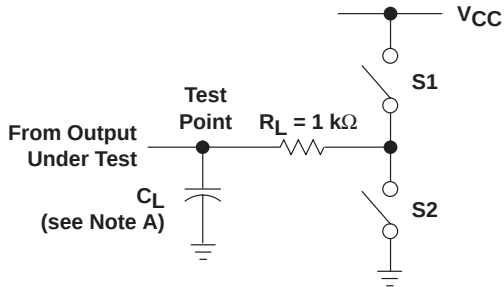
- NOTES:
- A.  $C_L$  includes probe and test-fixture capacitance.
  - B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled 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**

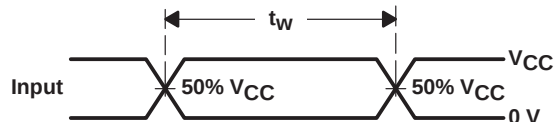
SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

**PARAMETER MEASUREMENT INFORMATION – 'HCT191**

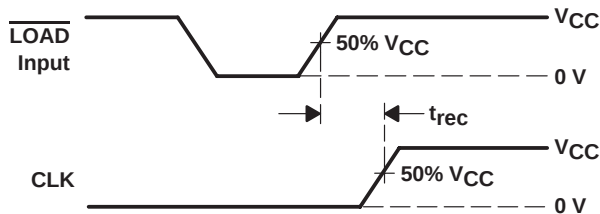


**LOAD CIRCUIT**

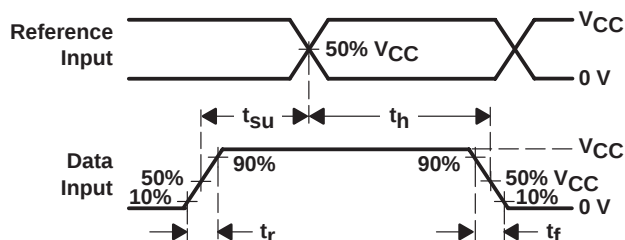
| PARAMETER         | S1        | S2     |
|-------------------|-----------|--------|
| $t_{en}$          | $t_{PZH}$ | Open   |
|                   | $t_{PZL}$ | Closed |
| $t_{dis}$         | $t_{PHZ}$ | Open   |
|                   | $t_{PLZ}$ | Closed |
| $t_{pd}$ or $t_t$ | Open      | Open   |



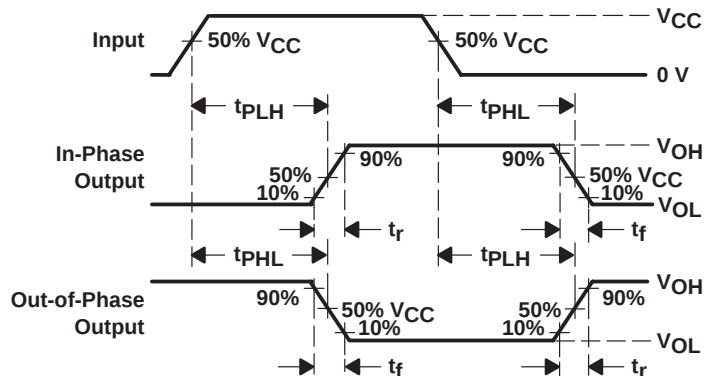
**VOLTAGE WAVEFORMS  
PULSE DURATION**



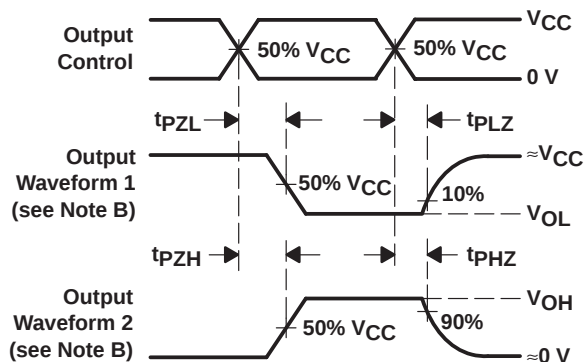
**VOLTAGE WAVEFORMS  
RECOVERY TIME**



**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:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r = 6\text{ ns}$ ,  $t_f = 6\text{ ns}$ .  
 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 5. Load Circuit and Voltage Waveforms**



## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>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                 |
|------------------|---------------|--------------|--------------------|------|----------------|---------------------|--------------------------------------|----------------------|--------------|---------------------------------|-------------------------|
| 5962-8867101EA   | ACTIVE        | CDIP         | J                  | 16   | 25             | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-8867101EA<br>CD54HCT191F3A | <a href="#">Samples</a> |
| 5962-8994601EA   | ACTIVE        | CDIP         | J                  | 16   | 25             | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-8994601EA<br>CD54HC190F3A  | <a href="#">Samples</a> |
| CD54HC190F3A     | ACTIVE        | CDIP         | J                  | 16   | 25             | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-8994601EA<br>CD54HC190F3A  | <a href="#">Samples</a> |
| CD54HC191F3A     | ACTIVE        | CDIP         | J                  | 16   | 25             | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-8689101EA<br>CD54HC191F3A  | <a href="#">Samples</a> |
| CD54HCT191F3A    | ACTIVE        | CDIP         | J                  | 16   | 25             | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-8867101EA<br>CD54HCT191F3A | <a href="#">Samples</a> |
| CD74HC190E       | ACTIVE        | PDIP         | N                  | 16   | 25             | RoHS & Green        | NIPDAU                               | N / A for Pkg Type   | -55 to 125   | CD74HC190E                      | <a href="#">Samples</a> |
| CD74HC190NSR     | ACTIVE        | SO           | NS                 | 16   | 2000           | RoHS & Green        | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HC190M                          | <a href="#">Samples</a> |
| CD74HC190PWR     | ACTIVE        | TSSOP        | PW                 | 16   | 2000           | RoHS & Green        | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HJ190                           | <a href="#">Samples</a> |
| CD74HC191E       | ACTIVE        | PDIP         | N                  | 16   | 25             | RoHS & Green        | NIPDAU                               | N / A for Pkg Type   | -55 to 125   | CD74HC191E                      | <a href="#">Samples</a> |
| CD74HC191M96     | ACTIVE        | SOIC         | D                  | 16   | 2500           | RoHS & Green        | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HC191M                          | <a href="#">Samples</a> |
| CD74HCT191E      | ACTIVE        | PDIP         | N                  | 16   | 25             | RoHS & Green        | NIPDAU                               | N / A for Pkg Type   | -55 to 125   | CD74HCT191E                     | <a href="#">Samples</a> |
| CD74HCT191M      | ACTIVE        | SOIC         | D                  | 16   | 40             | RoHS & Green        | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HCT191M                         | <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.

**OBSELETE:** 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.

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

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

<sup>(5)</sup> 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.

<sup>(6)</sup> 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.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF CD54HC190, CD54HC191, CD54HCT191, CD74HC190, CD74HC191, CD74HCT191 :**

- Catalog : [CD74HC190](#), [CD74HC191](#), [CD74HCT191](#)

- Military : [CD54HC190](#), [CD54HC191](#), [CD54HCT191](#)

**NOTE: Qualified Version Definitions:**

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

## TAPE AND REEL INFORMATION



\*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               | 6.9     | 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 | 356.0       | 356.0      | 35.0        |
| CD74HC190PWR | TSSOP        | PW              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| CD74HC191M96 | SOIC         | D               | 16   | 2500 | 340.5       | 336.1      | 32.0        |

## TUBE



\*All dimensions are nominal

| Device      | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| CD74HC190E  | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD74HC190E  | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD74HC191E  | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD74HC191E  | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD74HCT191E | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD74HCT191E | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| CD74HCT191M | D            | SOIC         | 16   | 40  | 507    | 8      | 3940   | 4.32   |



# PACKAGE OUTLINE

NS0016A

SOP - 2.00 mm max height

SOP



4220735/A 12/2021

## NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.





SOLDER PASTE EXAMPLE  
 BASED ON 0.125 mm THICK STENCIL  
 SCALE:7X

4220735/A 12/2021

NOTES: (continued)

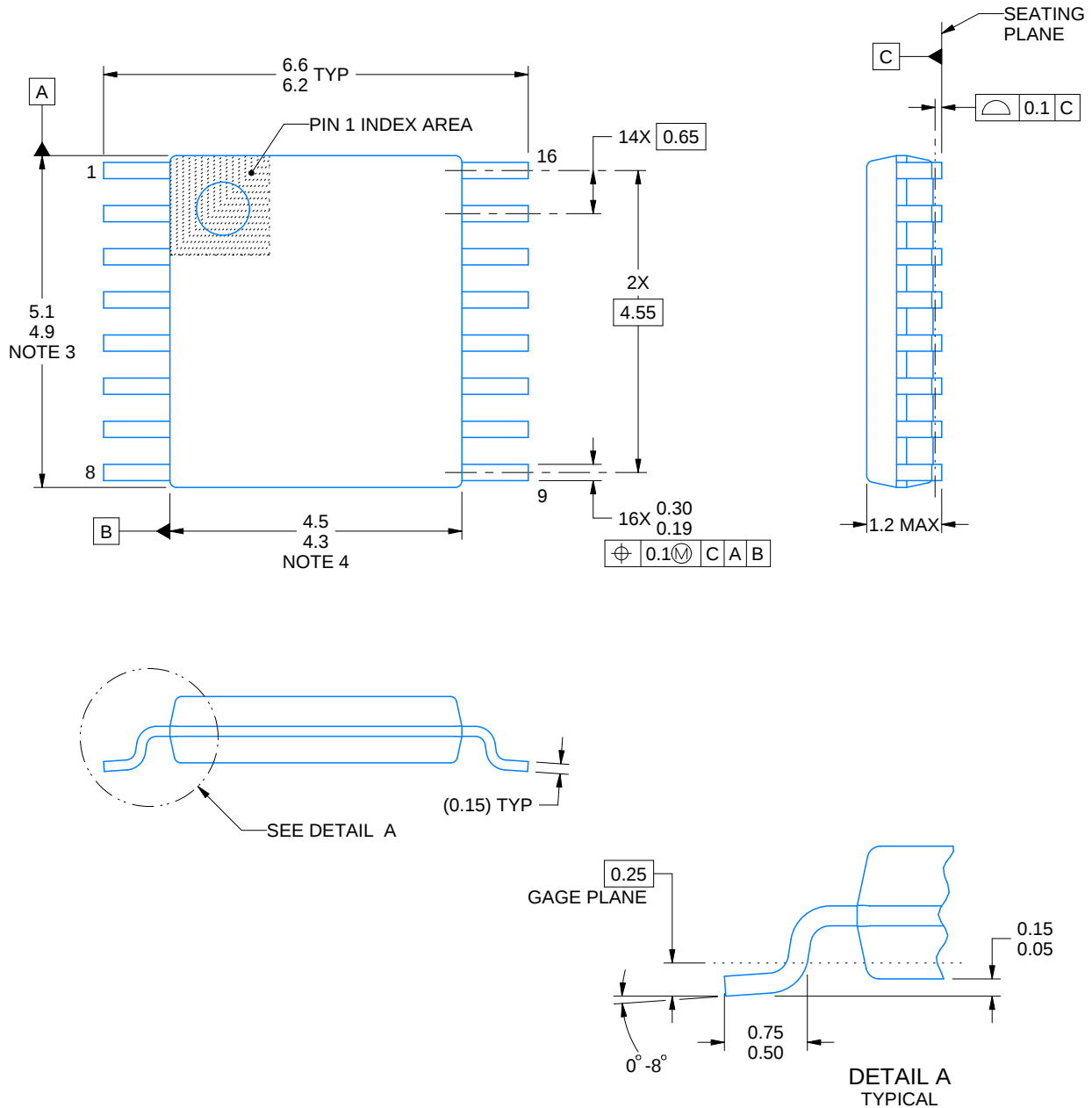
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  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.
  - $\triangle D$  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.



4220204/A 02/2017

## NOTES:

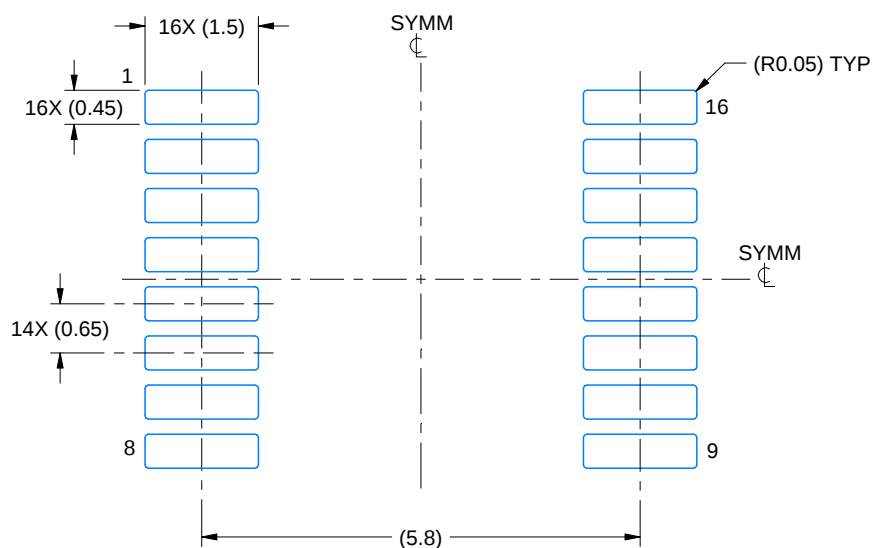
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

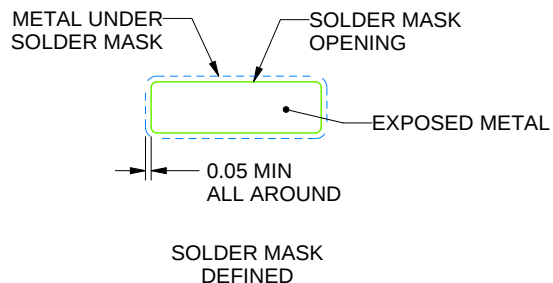
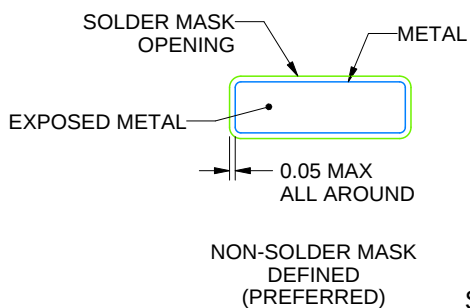
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220204/A 02/2017

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220204/A 02/2017

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

# MECHANICAL DATA

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

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN

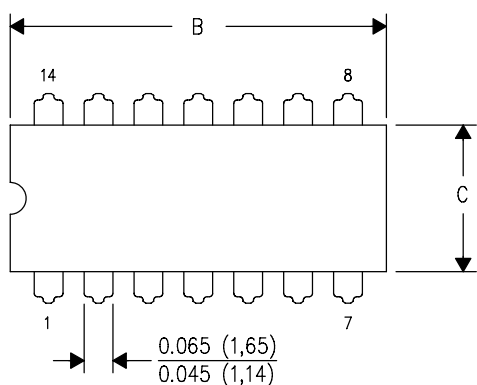


- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

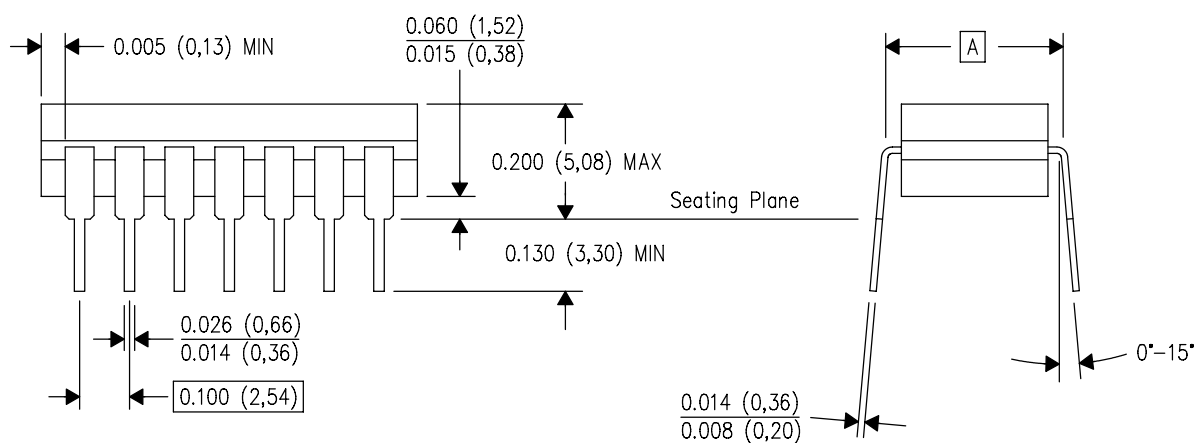
J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



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



4040083/F 03/03

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

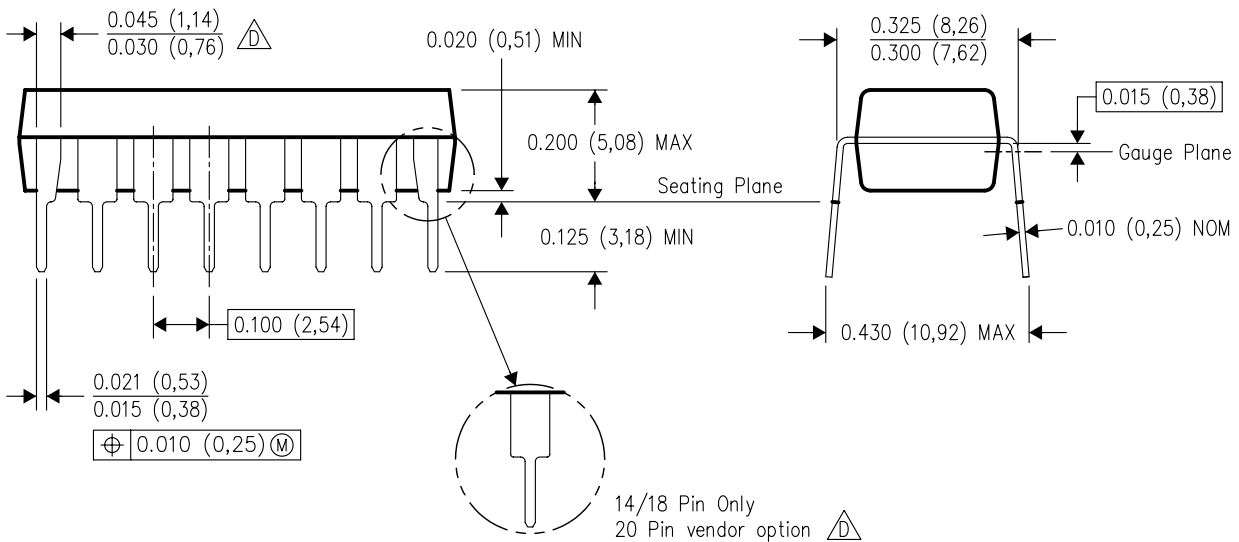
## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



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



14/18 Pin Only  
20 Pin vendor option

4040049/E 12/2002

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

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](#) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2024, Texas Instruments Incorporated