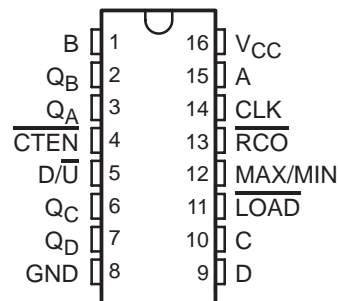


# CD54HC190, CD74HC190 CD54HC191, CD74HC191, CD54HCT191, CD74HCT191 SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL

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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	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

† 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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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



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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

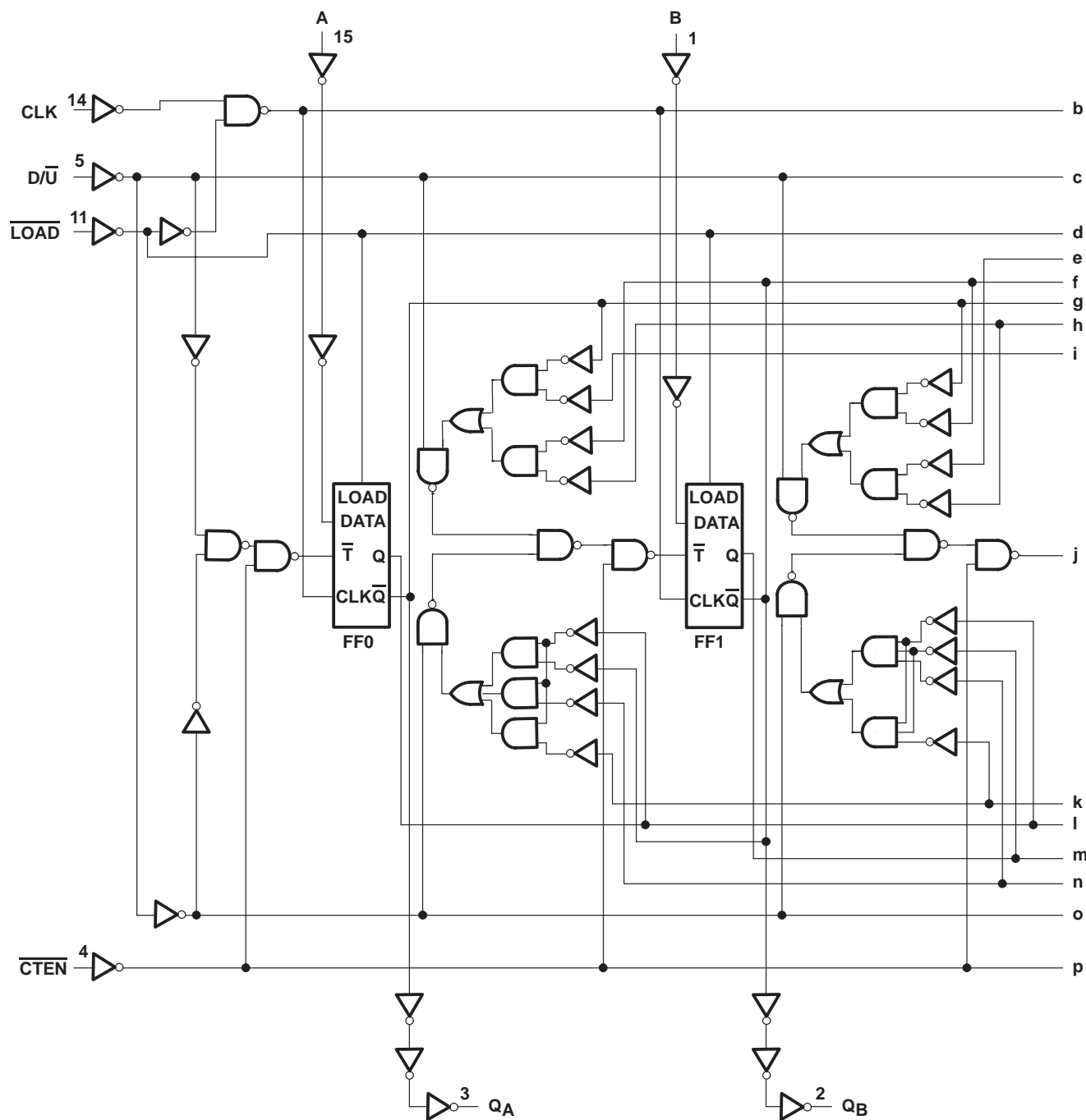
D/ $\overline{U}$  or  $\overline{CTEN}$  should be changed only when clock is high.

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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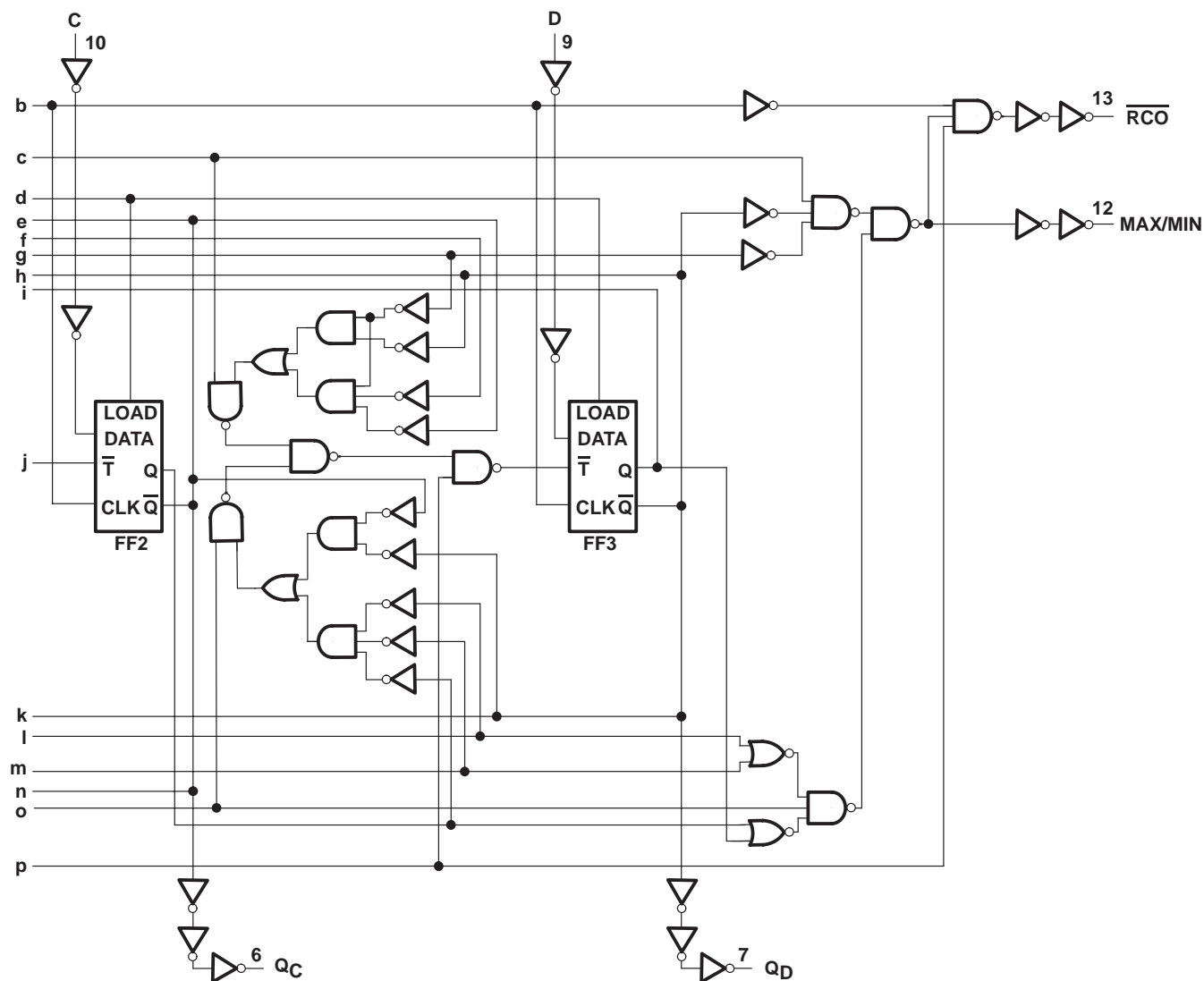
'HC190 logic diagram



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

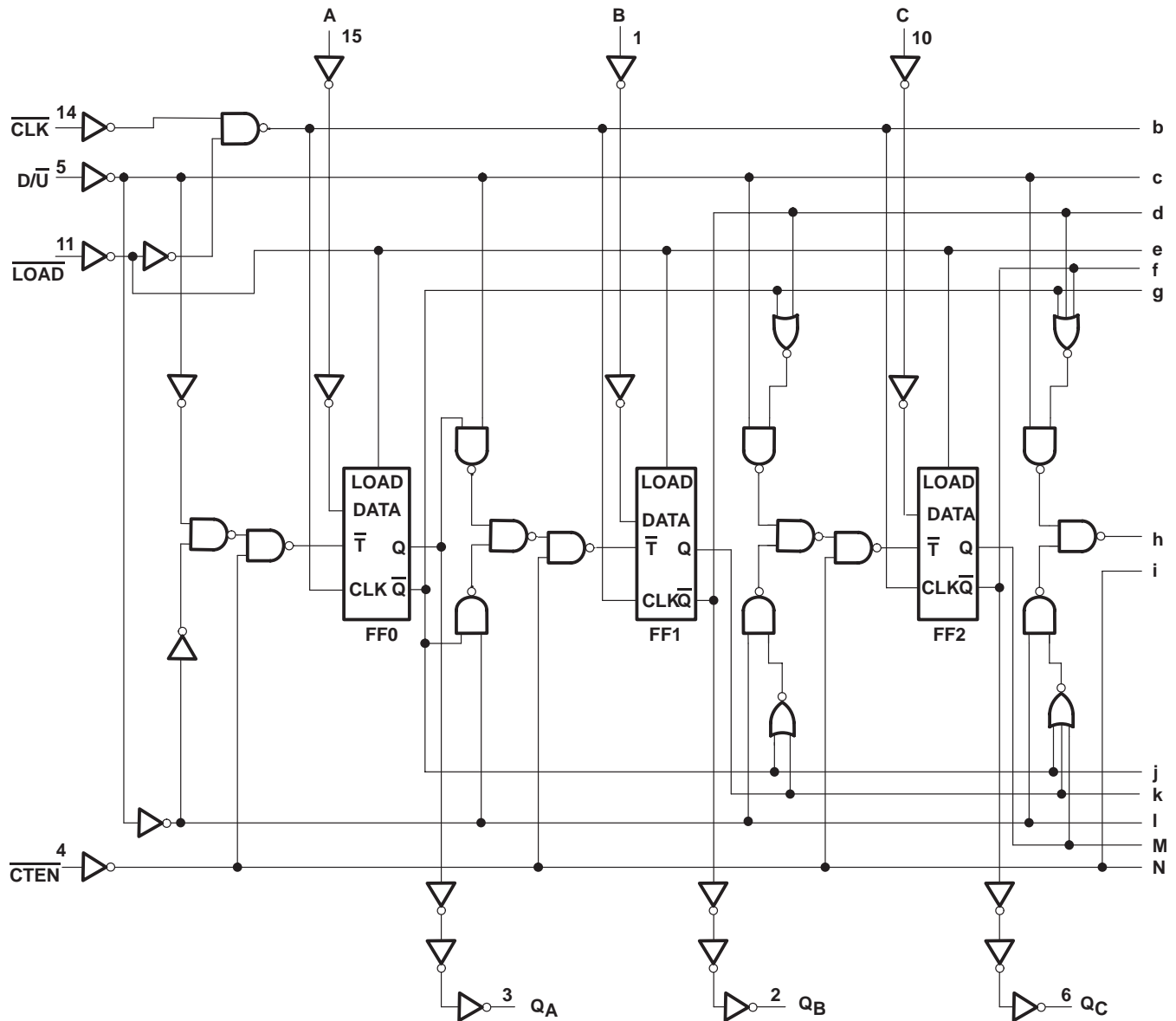
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**'HC190 logic diagram (continued)**



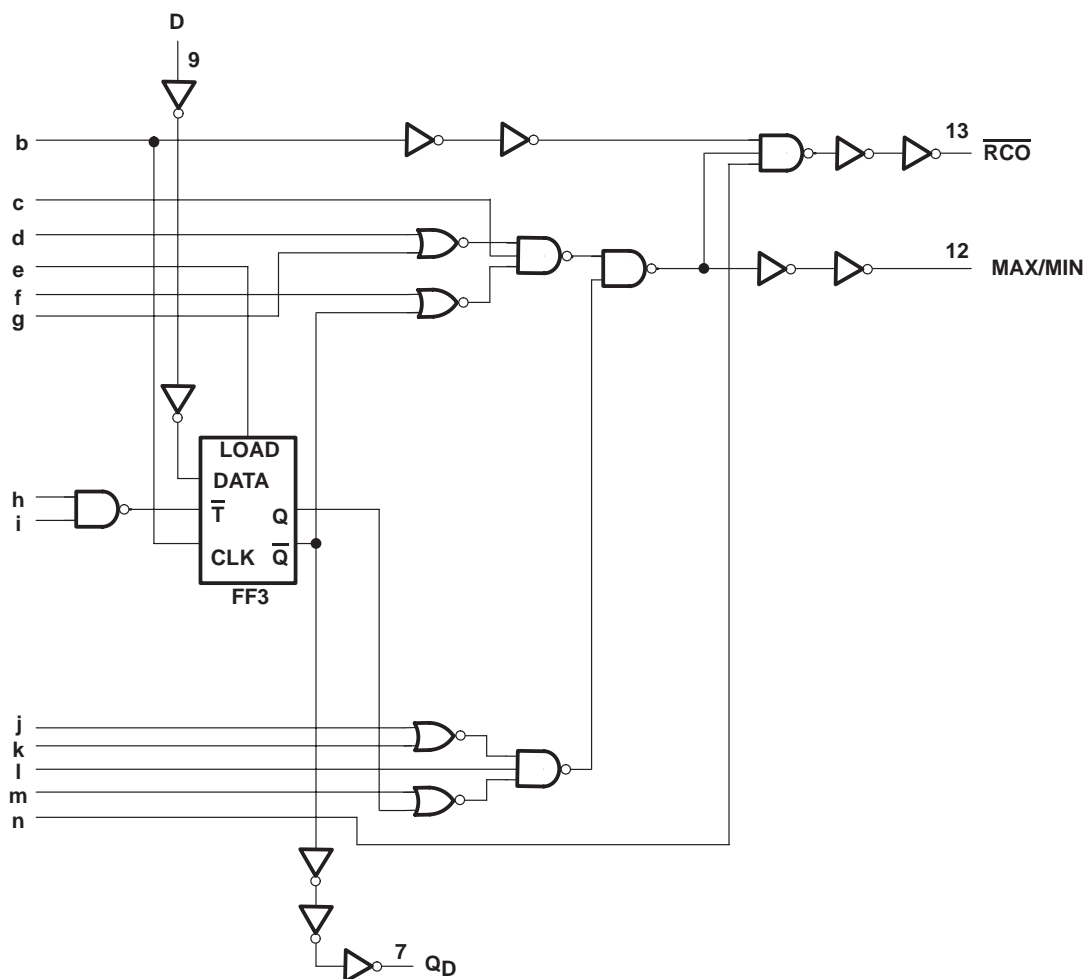
**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**  
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'HC191, 'HCT191 logic diagram

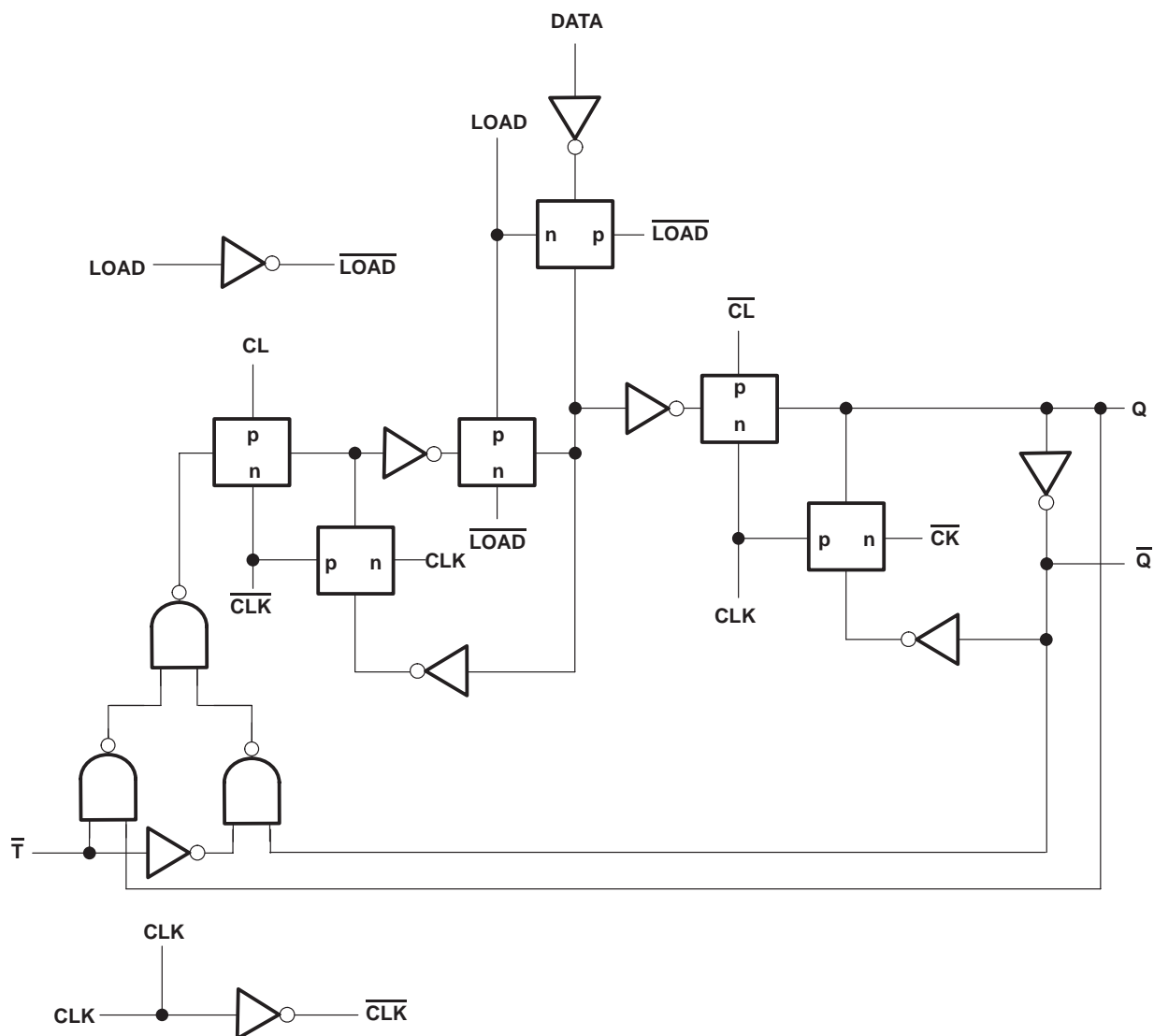


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### 'HC191, 'HCT191 logic diagram (continued)



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

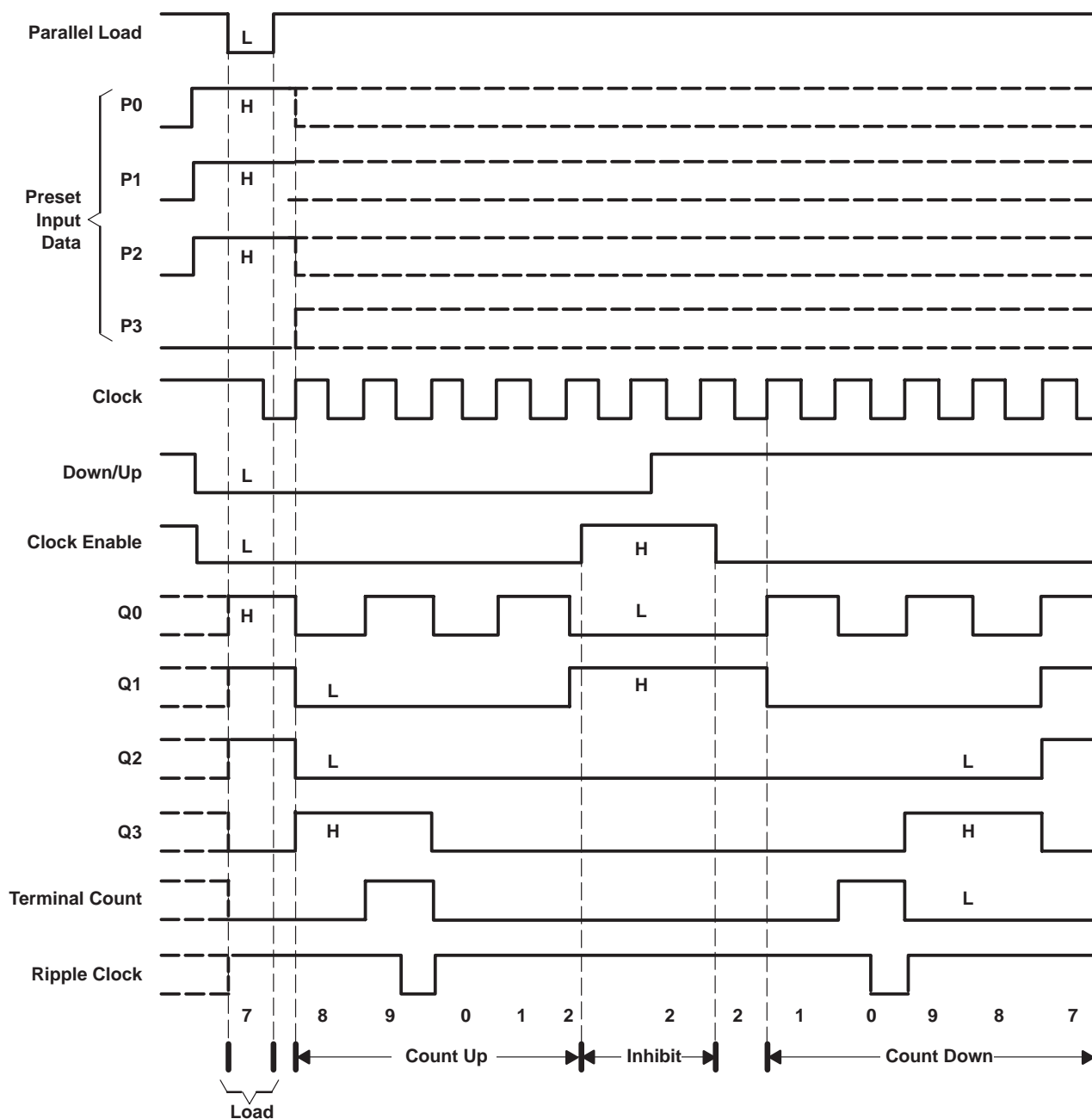


**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**  
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**typical load, count, and inhibit sequence for 'HC190**

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

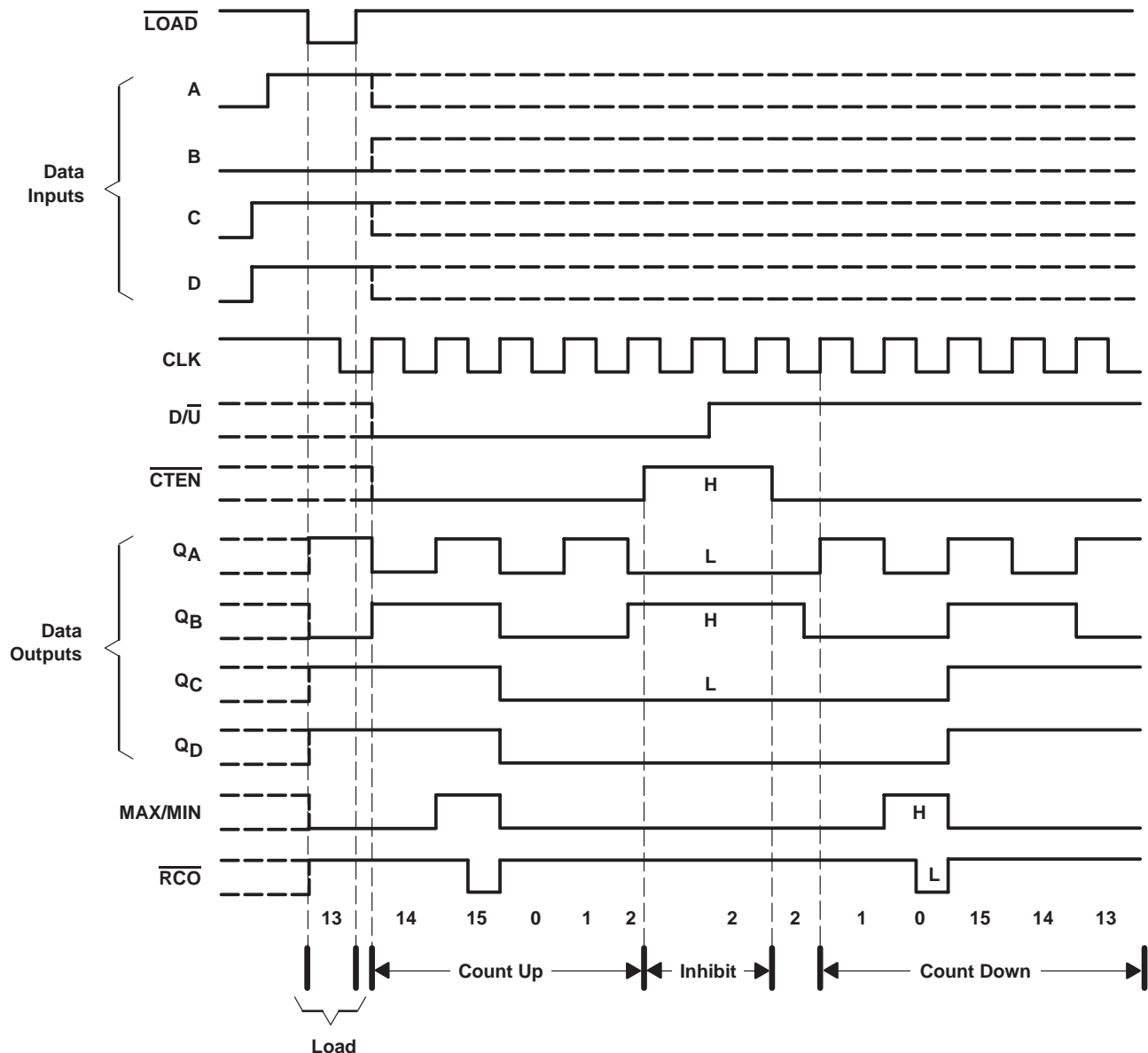




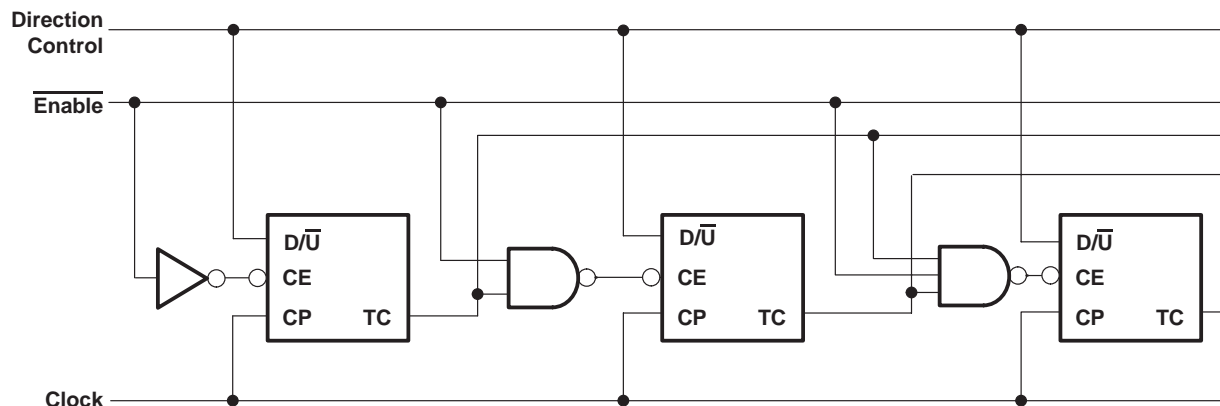
**typical load, count, and inhibit sequence for 'HC191 and 'HCT191**

The following sequence is illustrated below:

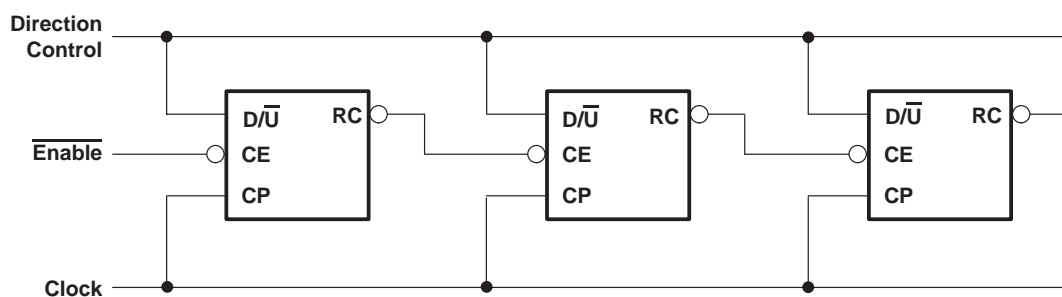
1. Load (preset) to binary 13
2. Count up to 14, 15 (maximum), 0, 1, and 2
3. Inhibit
4. Count down to 1, 0 (minimum), 15, 14, and 13



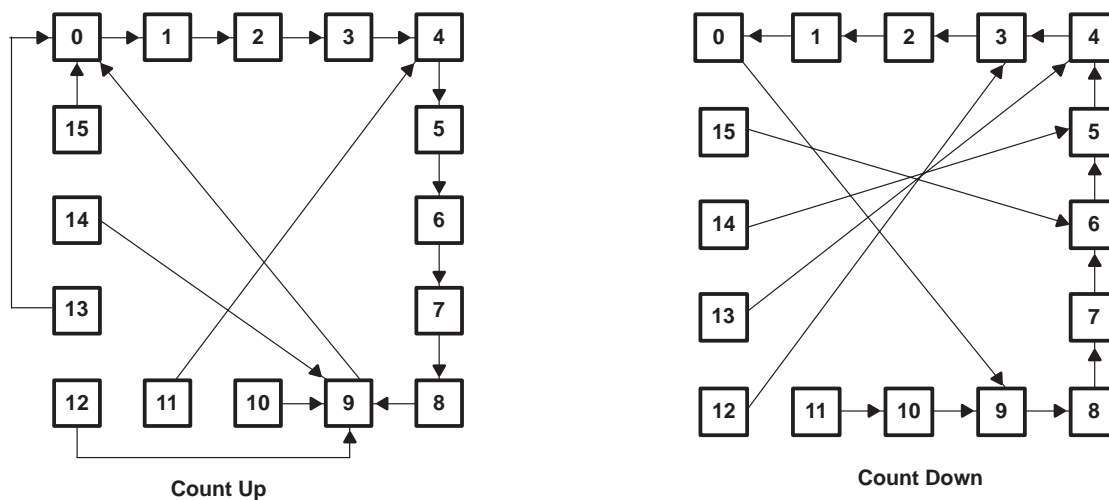
**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**  
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**Figure 1. 'HC190 Synchronous n-Stage Counter With Parallel Gated Terminal Count**



**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 JEDEC 51-7.

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

			$T_A = 25^\circ\text{C}$		$T_A = -55^\circ\text{C}$ TO $125^\circ\text{C}$		$T_A = -40^\circ\text{C}$ 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)**

			$T_A = 25^\circ\text{C}$		$T_A = -55^\circ\text{C}$ TO $125^\circ\text{C}$		$T_A = -40^\circ\text{C}$ 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		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**

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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		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**  
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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)

			$T_A = 25^\circ\text{C}$		$T_A = -55^\circ\text{C}$ TO $125^\circ\text{C}$		$T_A = -40^\circ\text{C}$ 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	$V_{CC}$	$T_A = 25^\circ\text{C}$			$T_A = -55^\circ\text{C}$ TO $125^\circ\text{C}$		$T_A = -40^\circ\text{C}$ 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**

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

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

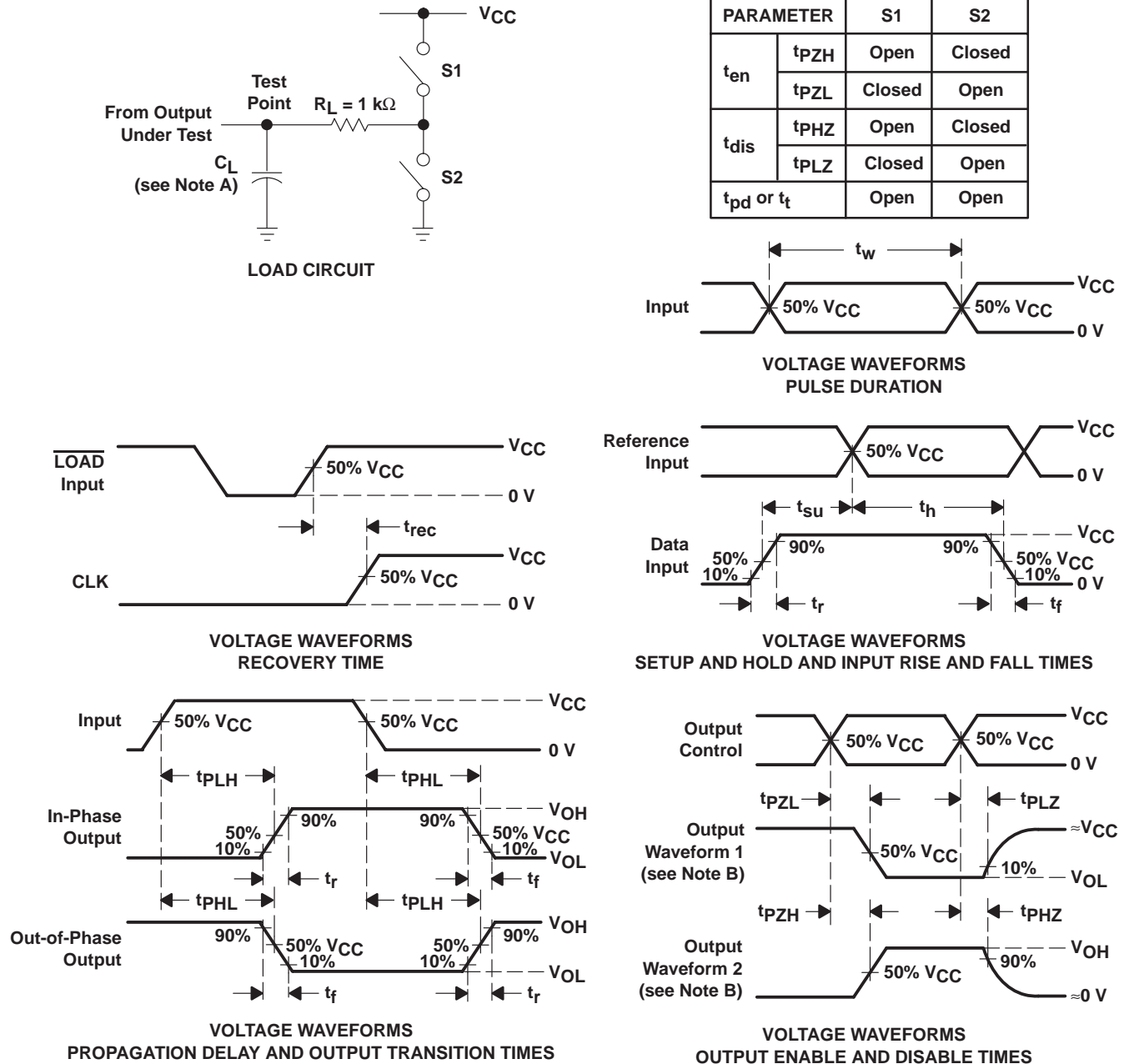
PARAMETER		TYP	UNIT
$C_{pd}$ Power dissipation capacitance	'HC190	59	pF
	'HC191	55	
	'HCT191	68	



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

SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

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

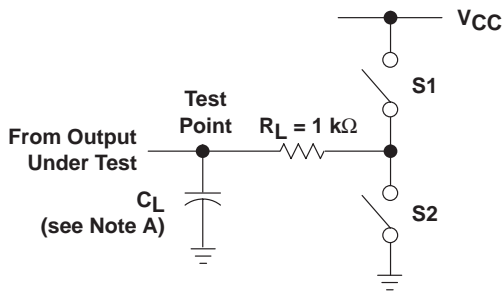


- NOTES: A.  $C_L$  includes probe and test-fixture capacitance.  
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by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

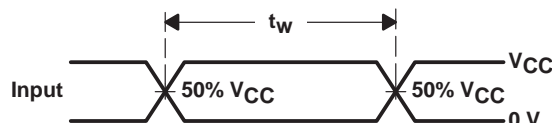
**CD54HC190, CD74HC190**  
**CD54HC191, CD74HC191, CD54HCT191, CD74HCT191**  
**SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL**  
 SCHS275E – MARCH 2002 – REVISED OCTOBER 2003

**PARAMETER MEASUREMENT INFORMATION – 'HCT191**

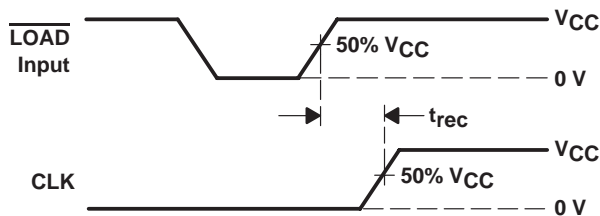


**LOAD CIRCUIT**

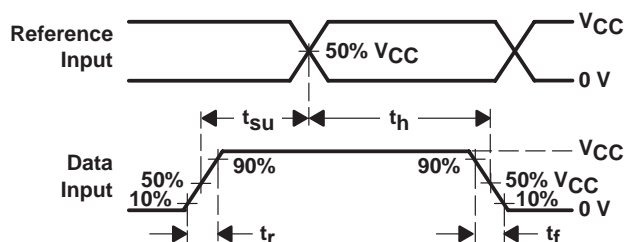
PARAMETER	S1	S2
$t_{en}$	$t_{PZH}$	Open
	$t_{PZL}$	Closed
$t_{dis}$	$t_{PHZ}$	Open
	$t_{PLZ}$	Closed
$t_{pd}$ or $t_t$	Open	Open



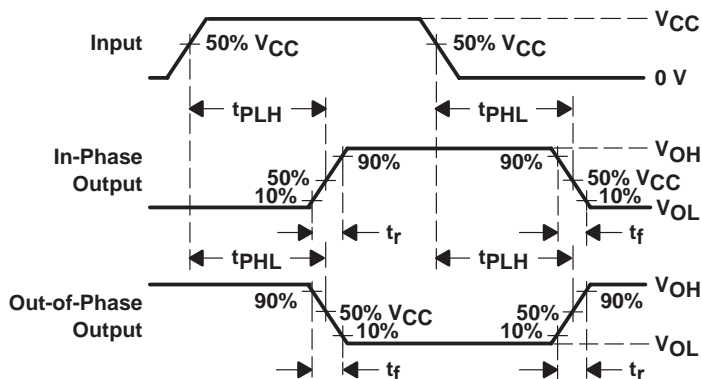
**VOLTAGE WAVEFORMS  
PULSE DURATION**



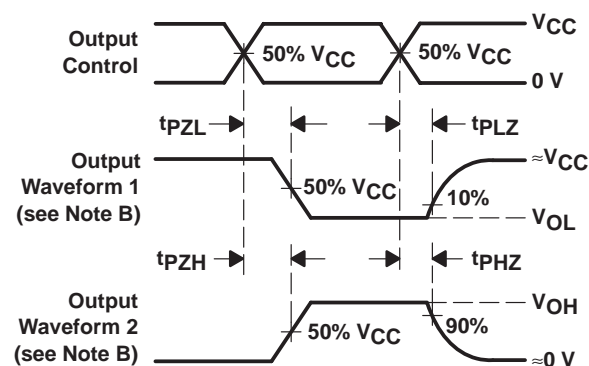
**VOLTAGE WAVEFORMS  
RECOVERY TIME**



**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 part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">5962-8867101EA</a>	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8867101EA CD54HCT191F3A
<a href="#">5962-8994601EA</a>	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8994601EA CD54HC190F3A
<a href="#">CD54HC190F3A</a>	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8994601EA CD54HC190F3A
CD54HC190F3A.A	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8994601EA CD54HC190F3A
<a href="#">CD54HC191F3A</a>	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8689101EA CD54HC191F3A
CD54HC191F3A.A	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8689101EA CD54HC191F3A
<a href="#">CD54HCT191F3A</a>	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8867101EA CD54HCT191F3A
CD54HCT191F3A.A	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8867101EA CD54HCT191F3A
<a href="#">CD74HC190E</a>	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HC190E
CD74HC190E.A	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HC190E
<a href="#">CD74HC190NSR</a>	Active	Production	SOP (NS)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC190M
CD74HC190NSR.A	Active	Production	SOP (NS)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC190M
<a href="#">CD74HC190PW</a>	Obsolete	Production	TSSOP (PW)   16	-	-	Call TI	Call TI	-55 to 125	HJ190
<a href="#">CD74HC190PWR</a>	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HJ190
CD74HC190PWR.A	Active	Production	TSSOP (PW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HJ190
<a href="#">CD74HC191E</a>	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HC191E
CD74HC191E.A	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HC191E
<a href="#">CD74HC191M</a>	Obsolete	Production	SOIC (D)   16	-	-	Call TI	Call TI	-55 to 125	HC191M
<a href="#">CD74HC191M96</a>	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC191M
CD74HC191M96.A	Active	Production	SOIC (D)   16	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC191M
<a href="#">CD74HC191MT</a>	Obsolete	Production	SOIC (D)   16	-	-	Call TI	Call TI	-55 to 125	HC191M
<a href="#">CD74HCT191E</a>	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HCT191E
CD74HCT191E.A	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HCT191E

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">CD74HCT191M</a>	Active	Production	SOIC (D)   16	40   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCT191M
CD74HCT191M.A	Active	Production	SOIC (D)   16	40   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCT191M

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts 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.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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**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	SOP	NS	16	2000	330.0	16.4	8.1	10.4	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	SOP	NS	16	2000	353.0	353.0	32.0
CD74HC190PWR	TSSOP	PW	16	2000	353.0	353.0	32.0
CD74HC191M96	SOIC	D	16	2500	353.0	353.0	32.0

## TUBE



\*All dimensions are nominal

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



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.

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

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



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



4220204/B 12/2023

## 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/B 12/2023

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/B 12/2023

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.

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

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



PINS **	14	16	18	20
DIM				
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 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.



NS0016A

# PACKAGE OUTLINE

SOP - 2.00 mm max height

SOP



4220735/A 12/2021

## NOTES:

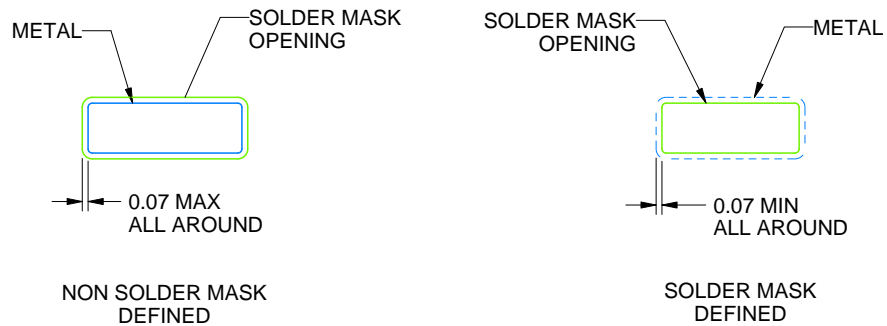
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate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

# EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



4220735/A 12/2021

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

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



# EXAMPLE STENCIL DESIGN

NS0016A

SOP - 2.00 mm max height

SOP



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.

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