

# HD74LS190 ● Synchronous Up/Down Decade Counters (single clock line)

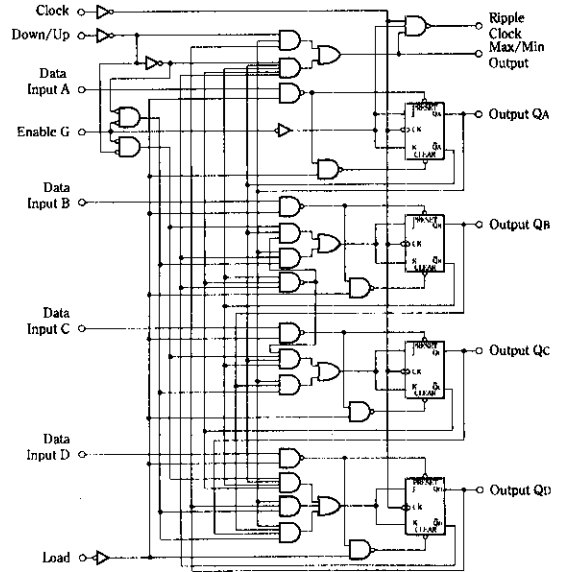
Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when so instructed by the steering logic. This mode of operation eliminates the output counting spikes normally associated with asynchronous (ripple clock) counters.

The outputs of the four master-slave flip-flops are triggered on a low-to-high-level transition of the clock input if the enable input is low. A high at the enable input inhibits counting. Level changes at the enable input should be made only when the clock input is high. The direction of the count is determined by the level of the down/up input. When low, the counter counts up and when high, it counts down. Level changes at the down/up input should be made only when the clock input is high. This counter is fully programmable; that is, the outputs may be preset to either level by placing a low on the load input and entering the desired data at the data inputs. The output will change to agree with the data inputs independently of the level of the clock input. This feature allows the counters to be used as modulo-N dividers by simply modifying the count length with the preset inputs. The clock, down/up, and load inputs are buffered to lower the drive requirement which significantly reduces the number of clock drivers, etc., required for long parallel words.

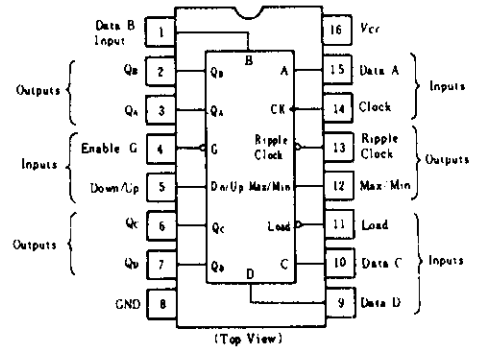
Two outputs have been made available to perform the cascading function: ripple clock and maximum/minimum count. The latter output produces a high-level output pulse with a duration approximately equal to one complete cycle to the clock when the counter overflows or underflows. The ripple clock output produces a low-level output pulse equal in width to the low-level portion of the clock input when an overflow or underflow condition exists.

The counters can be easily cascaded by feeding the ripple clock output to the enable input of the succeeding counter if parallel clocking is used, or to the clock input if parallel enabling is used. The maximum/minimum count output can be used to accomplish look-ahead for high-speed operation.

## ■ BLOCK DIAGRAM



## ■ PIN ARRANGEMENT



## ■ RECOMMENDED OPERATING CONDITIONS

Item	Symbol	min	typ	max	Unit
Clock frequency	$f_{clock}$	0	—	20	MHz
Clock pulse width	$t_w(CK)$	25	—	—	ns
Load input pulse width	$t_w(load)$	35	—	—	ns
Setup time	$t_{sa}$	20	—	—	ns
Hold time	$t_h$	3	—	—	ns
Enable time	$t_{enable}$	40	—	—	ns

# HD74LS190

## ■ ELECTRICAL CHARACTERISTICS ( $T_a = -20 \sim +75^\circ\text{C}$ )

Item	Symbol	Test Conditions	min	typ*	max	Unit	
Input voltage	$V_{IH}$		2.0	-	-	V	
	$V_{IL}$		-	-	0.8	V	
Output voltage	$V_{OH}$	$V_{CC} = 4.75\text{V}$ , $V_{IH} = 2\text{V}$ , $V_{IL} = 0.8\text{V}$ , $I_{OH} = -400\mu\text{A}$	2.7	-	-	V	
	$V_{OL}$	$V_{CC} = 4.75\text{V}$ , $V_{IH} = 2\text{V}$ , $V_{IL} = 0.8\text{V}$	$I_{OL} = 4\text{mA}$	-	-	0.4	V
			$I_{OL} = 8\text{mA}$	-	-	0.5	
Input current	Enable	$I_{IH}$	$V_{CC} = 5.25\text{V}$ , $V_I = 2.7\text{V}$	-	-	60	$\mu\text{A}$
				Others	-	-	
	Enable	$I_{IL}$	$V_{CC} = 5.25\text{V}$ , $V_I = 0.4\text{V}$	-	-	-1.2	mA
				Others	-	-	
	Enable	$I_I$	$V_{CC} = 5.25\text{V}$ , $V_I = 7\text{V}$	-	-	0.3	mA
				Others	-	-	
Short-circuit output current	$I_{OS}$	$V_{CC} = 5.25\text{V}$	-20	-	-100	mA	
Supply current**	$I_{CC}$	$V_{CC} = 5.25\text{V}$	-	20	35	mA	
Input clamp voltage	$V_{IK}$	$V_{CC} = 4.75\text{V}$ , $I_{IN} = -18\text{mA}$	-	-	-1.5	V	

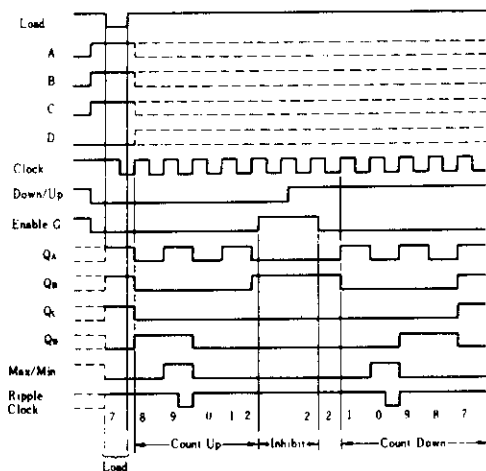
\*  $V_{CC} = 5\text{V}$ ,  $T_a = 25^\circ\text{C}$

\*\*  $I_{CC}$  is measured with all outputs open and all inputs grounded.

## ■ SWITCHING CHARACTERISTICS ( $V_{CC} = 5\text{V}$ , $T_a = 25^\circ\text{C}$ )

Item	Symbol	Inputs	Outputs	Test Conditions	min	typ	max	Unit	
Maximum clock frequency	$f_{max}$	Clock	QA, QB, QC, QD	$C_L = 15\text{pF}$ $R_L = 2\text{k}\Omega$	20	25	-	MHz	
Propagation delay time	$t_{PLH}$	Load	QA, QB, QC, QD		-	-	22	33	ns
					$t_{PHL}$	A, B, C, D	QA, QB, QC, QD	-	
	$t_{PLH}$	Clock	Ripple Clock					-	-
					$t_{PHL}$	Clock	QA, QB, QC, QD	-	-
	$t_{PLH}$	Clock	Max/Min					-	-
					$t_{PHL}$	Down/Up	Ripple Clock	-	-
	$t_{PLH}$	Down/Up	Max/Min					-	-
					$t_{PHL}$	Enable	Ripple Clock	-	-
	$t_{PLH}$	Enable	Ripple Clock					-	-
					$t_{PHL}$	Enable	Ripple Clock	-	-
	$t_{PLH}$	Enable	Ripple Clock					-	-
					$t_{PHL}$	Enable	Ripple Clock	-	-
	$t_{PLH}$	Enable	Ripple Clock					-	-
					$t_{PHL}$	Enable	Ripple Clock	-	-
	$t_{PLH}$	Enable	Ripple Clock					-	-
				$t_{PHL}$	Enable	Ripple Clock	-	-	22

## ■ COUNT SEQUENCES

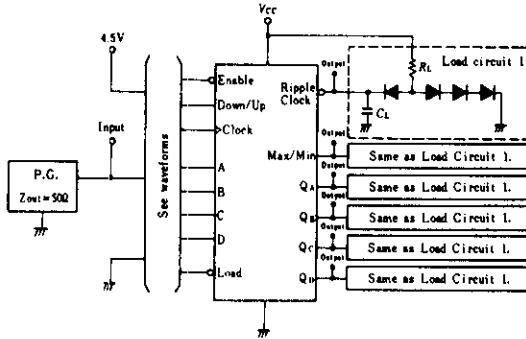


Illustrated below is the following sequence:

1. Load (preset) to BCD seven.
2. Count up to eight, nine (maximum), zero, one and two.
3. Inhibit
4. Count down to one, zero (minimum), nine, eight, and seven.

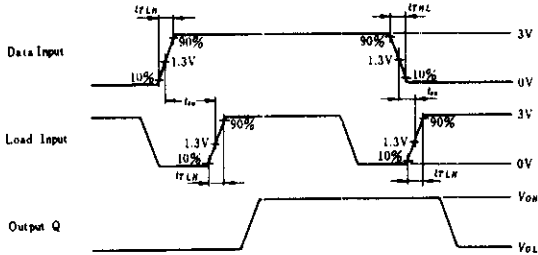
## TESTING METHOD

### 1) Test Circuit



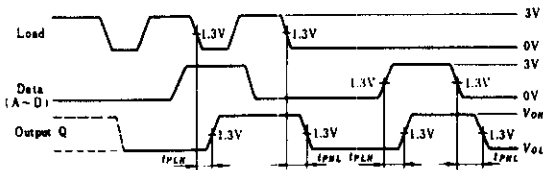
- Notes) 1.  $C_L$  includes probe and jig capacitance.  
2. All diodes are 1S2074 (H).

### Waveform



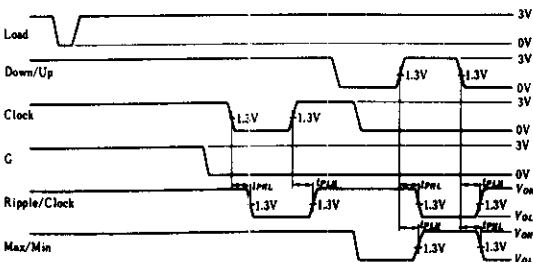
Input pulse:  $t_{TLH}, t_{THL} \leq 10\text{ns}$ ,  $PRR=1\text{MHz}$ , Duty cycle  $\leq 50\%$

### Waveform 1. Load→Q, Data→Q



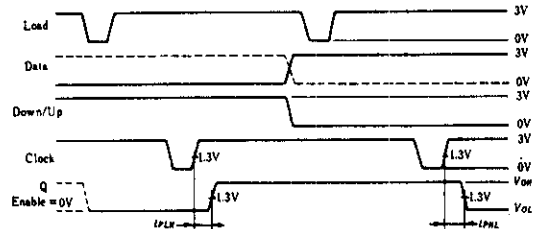
Note) Conditions on other inputs are irrelevant

### Waveform 2. G→Ripple CK, CK→Ripple CK, Down/UP→Ripple CK, Down/Up→Max/Min



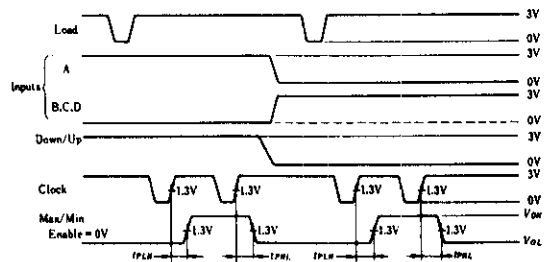
Note) All data inputs are low

### Waveform 3. Clock→Q

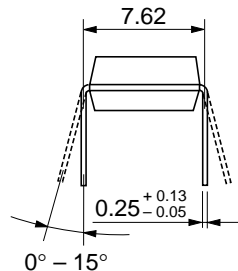
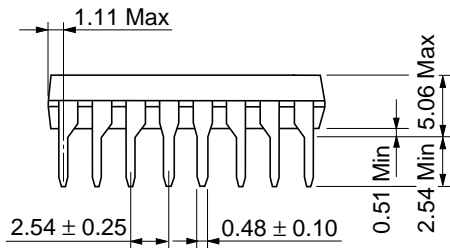
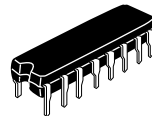
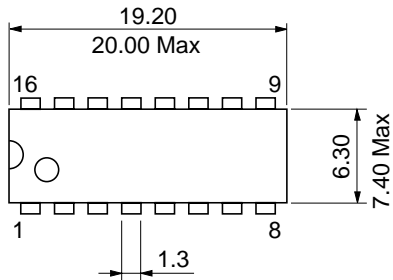


- Notes) 1. When test the  $Q_A$ ,  $Q_B$ , and  $Q_C$  outputs, data inputs A, B and C are shown by the solid line, and data input D is shown by the dashed line.  
2. When test the  $Q_D$  output, data inputs A and D are shown by the solid line, and data inputs B and C are held at the low logic level.

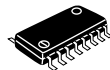
### Waveform 4. Clock→Max/Min



Note) Data inputs B and C are shown by the dashed line. Data input D is shown by the solid line.



Hitachi Code	DP-16
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	1.07 g



\*Dimension including the plating thickness  
Base material dimension

Hitachi Code	FP-16DA
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.24 g



\*Dimension including the plating thickness  
 Base material dimension

Hitachi Code	FP-16DN
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	0.15 g

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