

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

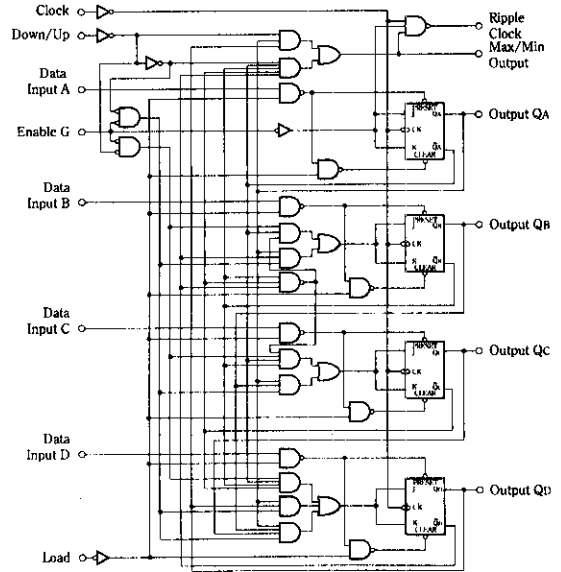
Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when so instructed by the steering logic. This mode of operation eliminates the output counting spikes normally associated with asynchronous (ripple clock) counters.

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.

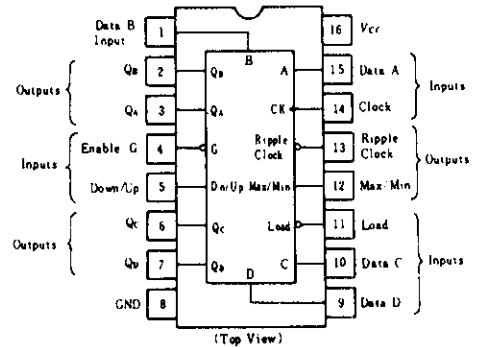
Two outputs have been made available to perform the cascading function: ripple clock and maximum/minimum count. The latter output produces a high-level output pulse with a duration approximately equal to one complete cycle to the clock when the counter overflows or underflows. The ripple clock output 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	$t_{c(CK)}$	25	—	—	ns
Load input pulse width	$t_{c(load)}$	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	

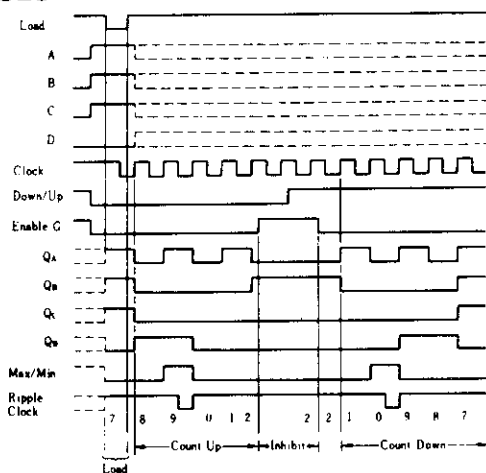
\*  $V_{CC} = 5\text{V}$ ,  $T_a = 25^\circ\text{C}$

\*\*  $I_{CC}$  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

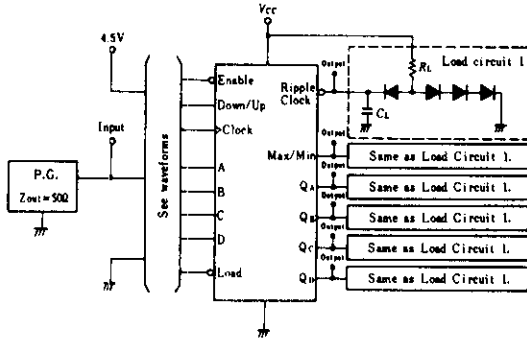


Illustrated below is the following sequence:

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.

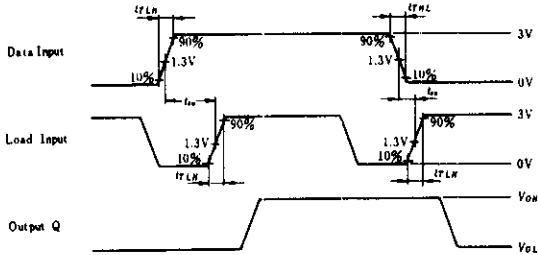
## TESTING METHOD

### 1) Test Circuit



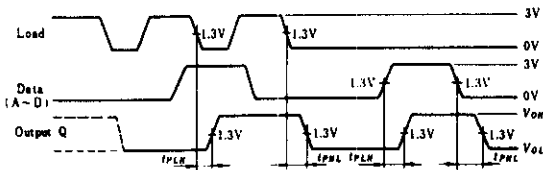
- Notes) 1.  $C_L$  includes probe and jig capacitance.  
2. All diodes are 1S2074 (H).

### Waveform



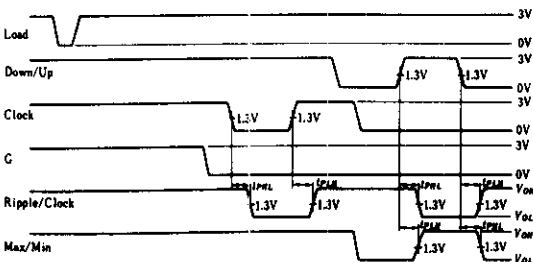
Input pulse:  $t_{TLH}, t_{THL} \leq 10\text{ns}$ ,  $PRR=1\text{MHz}$ , Duty cycle  $\leq 50\%$

### Waveform 1. Load→Q, Data→Q



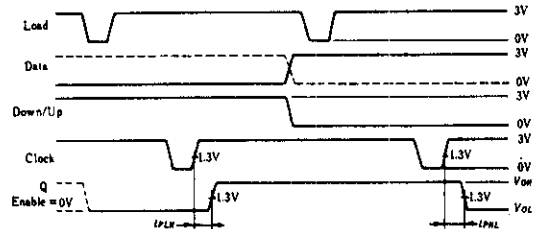
Note) Conditions on other inputs are irrelevant

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



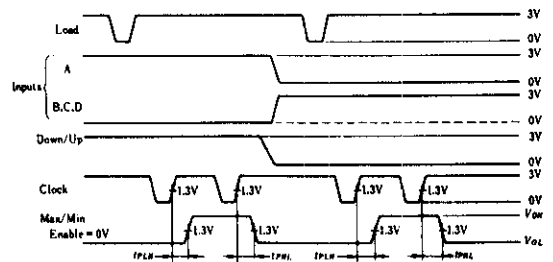
Note) All data inputs are low

### Waveform 3. Clock→Q

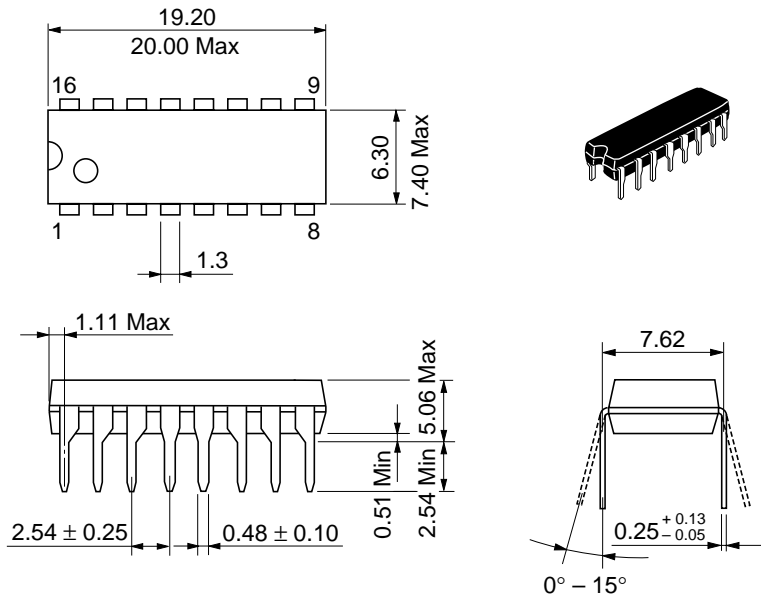


- Notes) 1. When test the  $Q_A, Q_B,$  and  $Q_C$  outputs, data inputs A, B and C are shown by the solid line, and data input D is shown by the dashed line.  
2. When test the  $Q_D$  output, data inputs A and D are shown by the solid line, and data inputs B and C are held at the low logic level.

### 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-16DN
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	0.15 g

## Cautions

1. Hitachi neither warrants nor grants licenses of any rights of Hitachi's or any third party's patent, copyright, trademark, or other intellectual property rights for information contained in this document. Hitachi bears no responsibility for problems that may arise with third party's rights, including intellectual property rights, in connection with use of the information contained in this document.
2. Products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
3. Hitachi makes every attempt to ensure that its products are of high quality and reliability. However, contact Hitachi's sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
4. Design your application so that the product is used within the ranges guaranteed by Hitachi particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. Hitachi bears no responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Hitachi product does not cause bodily injury, fire or other consequential damage due to operation of the Hitachi product.
5. This product is not designed to be radiation resistant.
6. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without written approval from Hitachi.
7. Contact Hitachi's sales office for any questions regarding this document or Hitachi semiconductor products.

# HITACHI

## Hitachi, Ltd.

Semiconductor & Integrated Circuits.  
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan  
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL      North America      : <http://semiconductor.hitachi.com/>  
             Europe                : <http://www.hitachi-eu.com/hel/ecg>  
             Asia (Singapore)      : <http://www.has.hitachi.com.sg/grp3/sicd/index.htm>  
             Asia (Taiwan)            : [http://www.hitachi.com.tw/E/Product/SICD\\_Frame.htm](http://www.hitachi.com.tw/E/Product/SICD_Frame.htm)  
             Asia (HongKong)        : <http://www.hitachi.com.hk/eng/bo/grp3/index.htm>  
             Japan                      : <http://www.hitachi.co.jp/Sicd/indx.htm>

## For further information write to:

Hitachi Semiconductor  
(America) Inc.  
179 East Tasman Drive,  
San Jose, CA 95134  
Tel: <1> (408) 433-1990  
Fax: <1>(408) 433-0223

Hitachi Europe GmbH  
Electronic components Group  
Dornacher Straße 3  
D-85622 Feldkirchen, Munich  
Germany  
Tel: <49> (89) 9 9180-0  
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.  
Electronic Components Group.  
Whitebrook Park  
Lower Cookham Road  
Maidenhead  
Berkshire SL6 8YA, United Kingdom  
Tel: <44> (1628) 585000  
Fax: <44> (1628) 778322

Hitachi Asia Pte. Ltd.  
16 Collyer Quay #20-00  
Hitachi Tower  
Singapore 049318  
Tel: 535-2100  
Fax: 535-1533

Hitachi Asia Ltd.  
Taipei Branch Office  
3F, Hung Kuo Building, No.167,  
Tun-Hwa North Road, Taipei (105)  
Tel: <886> (2) 2718-3666  
Fax: <886> (2) 2718-8180

Hitachi Asia (Hong Kong) Ltd.  
Group III (Electronic Components)  
7/F., North Tower, World Finance Centre,  
Harbour City, Canton Road, Tsim Sha Tsui,  
Kowloon, Hong Kong  
Tel: <852> (2) 735 9218  
Fax: <852> (2) 730 0281  
Telex: 40815 HITEC HX

Copyright ' Hitachi, Ltd., 1999. All rights reserved. Printed in Japan.

**HITACHI**



LittleDiode supplies new, hard to find or obsolete electronic components and semiconductors all over the world.

With over two million different components listed you are sure to find the part you need.

Feel free to visit us today at our online store:

[LittleDiode.com](http://LittleDiode.com)

Looking forward to providing you with the best possible service.