
HD74HC160/HD74HC161/ HD74HC162/HD74HC163

Synchronous Decade Counter (Direct Clear)
Synchronous 4-bit Binary Counter (Direct Clear)
Synchronous Decade Counter (Synchronous Clear)
Synchronous 4-bit Binary Counter (Synchronous Clear)

HITACHI

ADE-205-455 (Z)
1st. Edition
Sep. 2000

Description

The HD74HC160 and the HD74HC162 are 4 bit decade counters, and the HD74HC161 and the HD74HC163 are 4 bit binary counters. All flip-flops are clocked simultaneously on the low to high to transition (positive edge) of the clock input waveform.

These counters may be preset using the load input. Presetting of all four flip-flops is synchronous to the rising edge of clock. When load is held low counting is disabled and the data on the A, B, C, and D inputs is loaded into the counter on the rising edge of clock. If the load input is taken high before the positive edge of clock the count operation will be unaffected.

All of these counters may be cleared by utilizing the clear input. The clear function on the HD74HC162 and HD74HC163 counters is synchronous to the clock. That is, the counters are cleared on the positive edge of clock while the clear input is held low.

The HD74HC160 and HD74HC161 counters are cleared asynchronously. When the clear is taken low the counter is cleared immediately regardless of the clock.

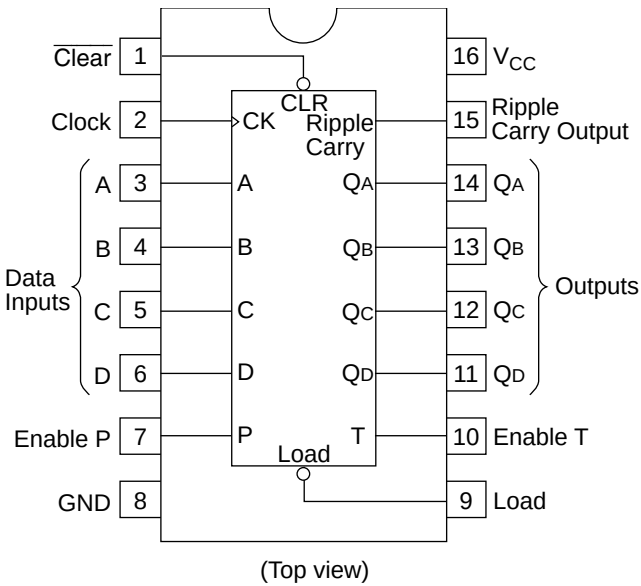
Two active high enable inputs Enable P and Enable T and a ripple carry output are provided to enable easy cascading of counters. Both enable inputs must be high to count. The Enable T input also enables the Ripple Carry output. When enabled, the Ripple Carry outputs a positive pulse when the counter overflows. This pulse is approximately equal in duration to the high level portion of the Q_A outputs. The Ripple Carry output is fed to successive cascaded stages to facilitate easy implementation of N-bit counters.

Features

- High Speed Operation: t_{pd} (Clock to Q) = 18 ns typ ($C_L = 50$ pF)
- High Output Current: Fanout of 10 LSTTL Loads
- Wide Operating Voltage: $V_{CC} = 2$ to 6 V
- Low Input Current: 1 μ A max
- Low Quiescent Supply Current: I_{CC} (static) = 4 μ A max ($T_a = 25^\circ\text{C}$)

HD74HC160/HD74HC161/HD74HC162/HD74HC163

Pin Arrangement



Function Table

Inputs					Outputs
Clock	$\overline{\text{Clear}}^{*1}$	$\overline{\text{Load}}$	Enable P	Enable T	Q_n
	L	X	X	X	Reset-clear
	H	L	X	X	Load input data
	H	H	H	H	Count
	H	H	L	X	No count
	H	H	X	L	No count

Note: 1. 162 and 163 Only-160 and 161 are Asynchronous Clear Devices

	Decade Counter	Binary Counter
Asynchronous clear	HD74HC160	HD74HC161
Synchronous clear	HD74HC162	HD74HC163

DC Characteristics

Item	Symbol	V _{CC} (V)	Ta = 25°C			Ta = -40 to +85°C		Unit	Test Conditions
			Min	Typ	Max	Min	Max		
Input voltage	V _{IH}	2.0	1.5	—	—	1.5	—	V	
		4.5	3.15	—	—	3.15	—		
		6.0	4.2	—	—	4.2	—		
	V _{IL}	2.0	—	—	0.5	—	0.5	V	
		4.5	—	—	1.35	—	1.35		
		6.0	—	—	1.8	—	1.8		
Output voltage	V _{OH}	2.0	1.9	2.0	—	1.9	—	V	Vin = V _{IH} or V _{IL} I _{OH} = -20 μA
		4.5	4.4	4.5	—	4.4	—		
		6.0	5.9	6.0	—	5.9	—		
		4.5	4.18	—	—	4.13	—		
		6.0	5.68	—	—	5.63	—		
	V _{OL}	2.0	—	0.0	0.1	—	0.1	V	Vin = V _{IH} or V _{IL} I _{OL} = 20 μA
		4.5	—	0.0	0.1	—	0.1		
		6.0	—	0.0	0.1	—	0.1		
		4.5	—	—	0.26	—	0.33		
		6.0	—	—	0.26	—	0.33		
Input current	I _{in}	6.0	—	—	±0.1	—	±1.0	μA	Vin = V _{CC} or GND
		6.0	—	—	4.0	—	40		
Quiescent supply current	I _{CC}	6.0	—	—	4.0	—	40	μA	Vin = V _{CC} or GND, I _{out} = 0 μA

HD74HC160/HD74HC161/HD74HC162/HD74HC163

AC Characteristics (C_L = 50 pF, Input t_r = t_f = 6 ns)

Item	Symbol	V _{CC} (V)	Ta = 25°C			Ta = -40 to +85°C		Unit	Test Conditions
			Min	Typ	Max	Min	Max		
Maximum clock frequency	f _{max}	2.0	—	—	5	—	4	MHz	
		4.5	—	—	25	—	20		
		6.0	—	—	29	—	23		
Propagation delay time	t _{PLH}	2.0	—	—	160	—	200	ns	Clock to Q
		4.5	—	18	32	—	40		
		6.0	—	—	27	—	34		
	t _{PHL}	2.0	—	—	225	—	280	ns	$\overline{\text{Clear}}$ to Q (HC160, HC161 only)
		4.5	—	23	45	—	56		
		6.0	—	—	38	—	48		
		2.0	—	—	150	—	190	ns	Enable T to Ripple Carry output
		4.5	—	15	30	—	38		
		6.0	—	—	26	—	33		
		2.0	—	—	200	—	250	ns	Clock to Ripple carry output
		4.5	—	16	40	—	50		
		6.0	—	—	34	—	43		
Setup time	t _{su}	2.0	125	—	—	156	—	ns	Data to Clock
		4.5	25	9	—	31	—		
		6.0	21	—	—	26	—		
		2.0	125	—	—	156	—		$\overline{\text{Load}}$ to Clock
		4.5	25	15	—	31	—		
		6.0	21	—	—	26	—		
		2.0	125	—	—	156	—		$\overline{\text{Clear}}$ to Clock (HC162, HC163 only)
		4.5	25	—	—	31	—		
		6.0	21	—	—	26	—		
Hold time	t _h	2.0	0	—	—	0	—	ns	
		4.5	0	-7	—	0	—		
		6.0	0	—	—	0	—		
Removal time	t _{rem}	2.0	100	—	—	125	—	ns	
		4.5	20	7	—	25	—		
		6.0	17	—	—	21	—		

AC Characteristics (C_L = 50 pF, Input t_r = t_f = 6 ns) (cont)

Item	Symbol	V _{cc} (V)	Ta = 25°C			Ta = -40 to +85°C		Unit	Test Conditions
			Min	Typ	Max	Min	Max		
Pulse width	t _w	2.0	80	—	—	100	—	ns	
		4.5	16	6	—	20	—		
		6.0	14	—	—	17	—		
Output rise/fall time	t _{TLH} t _{THL}	2.0	—	—	75	—	95	ns	
		4.5	—	5	15	—	19		
		6.0	—	—	13	—	16		
Input capacitance	Cin	—	—	5	10	—	10	pF	

Function Table

Count Enable/Disable

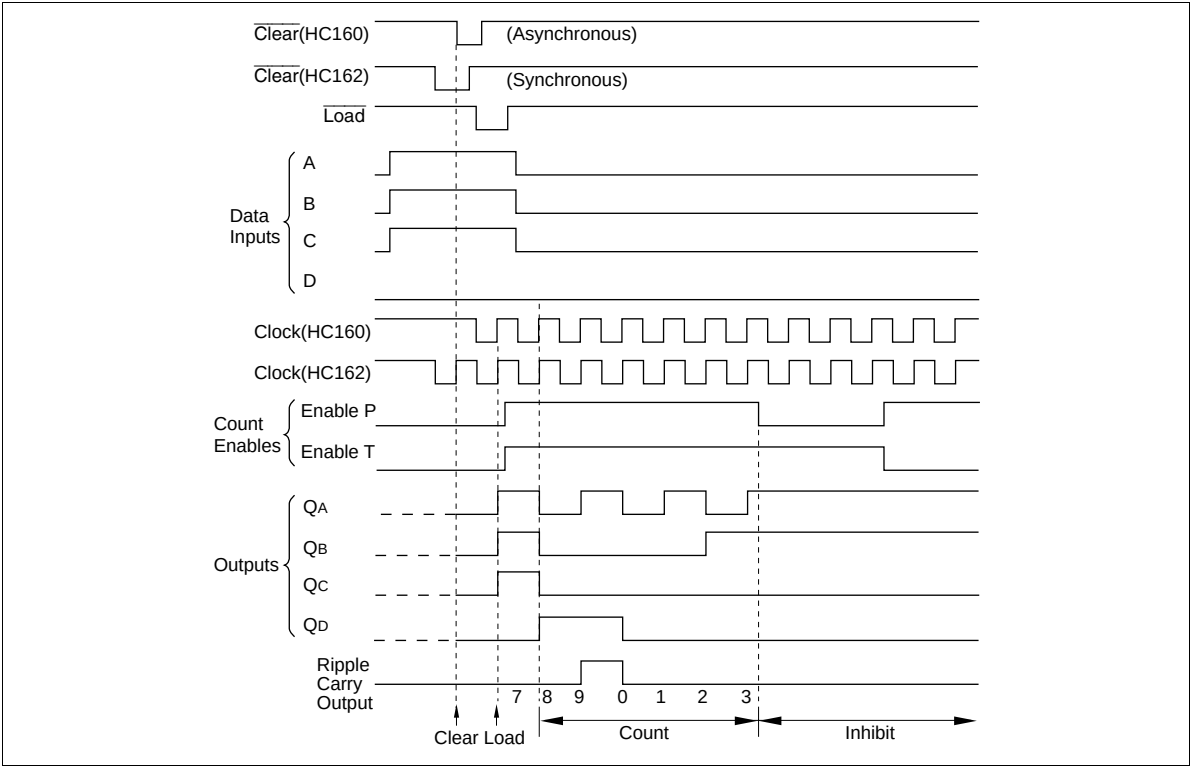
Control Inputs			Result at Outputs	
Load	Enable P	Enable T	Q _A to Q _D	Ripple Carry Output
H	H	H	Count	High when Q _A to Q _D are maximum
L	H	H	No count	
X	L	H	No count	High when Q _A to Q _D are maximum
X	H	L	No count	L
X	L	L	No count	L

Timing Diagram

HD74HC160/HD74HC162

Sequence illustrated in waveforms.

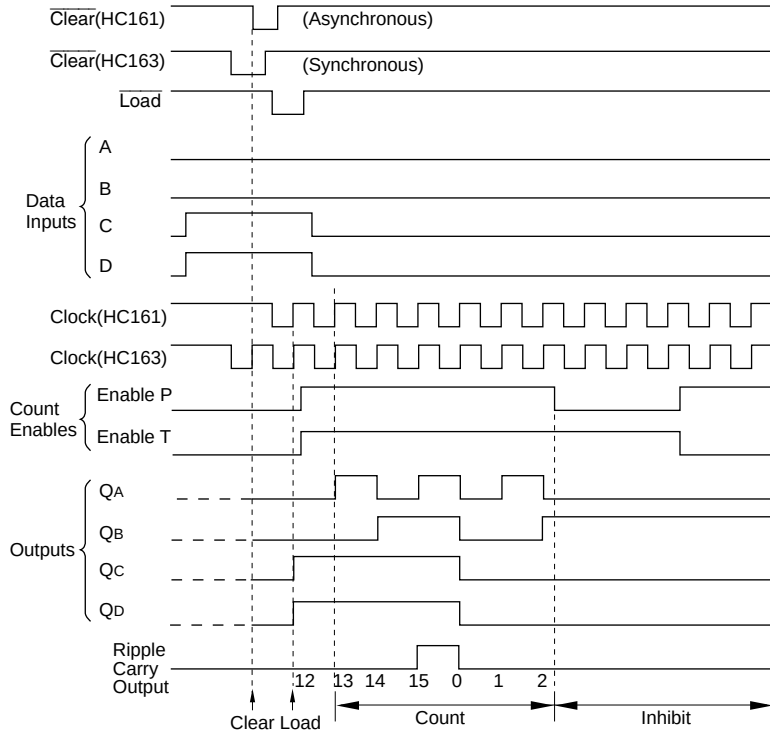
- 1. Clear outputs to zero.
- 2. Preset to BCD seven.
- 3. Count to eight, nine, zero, one, two and three.
- 4. Inhibit



HD74HC161/HD74HC163

Sequence illustrated in waveforms.

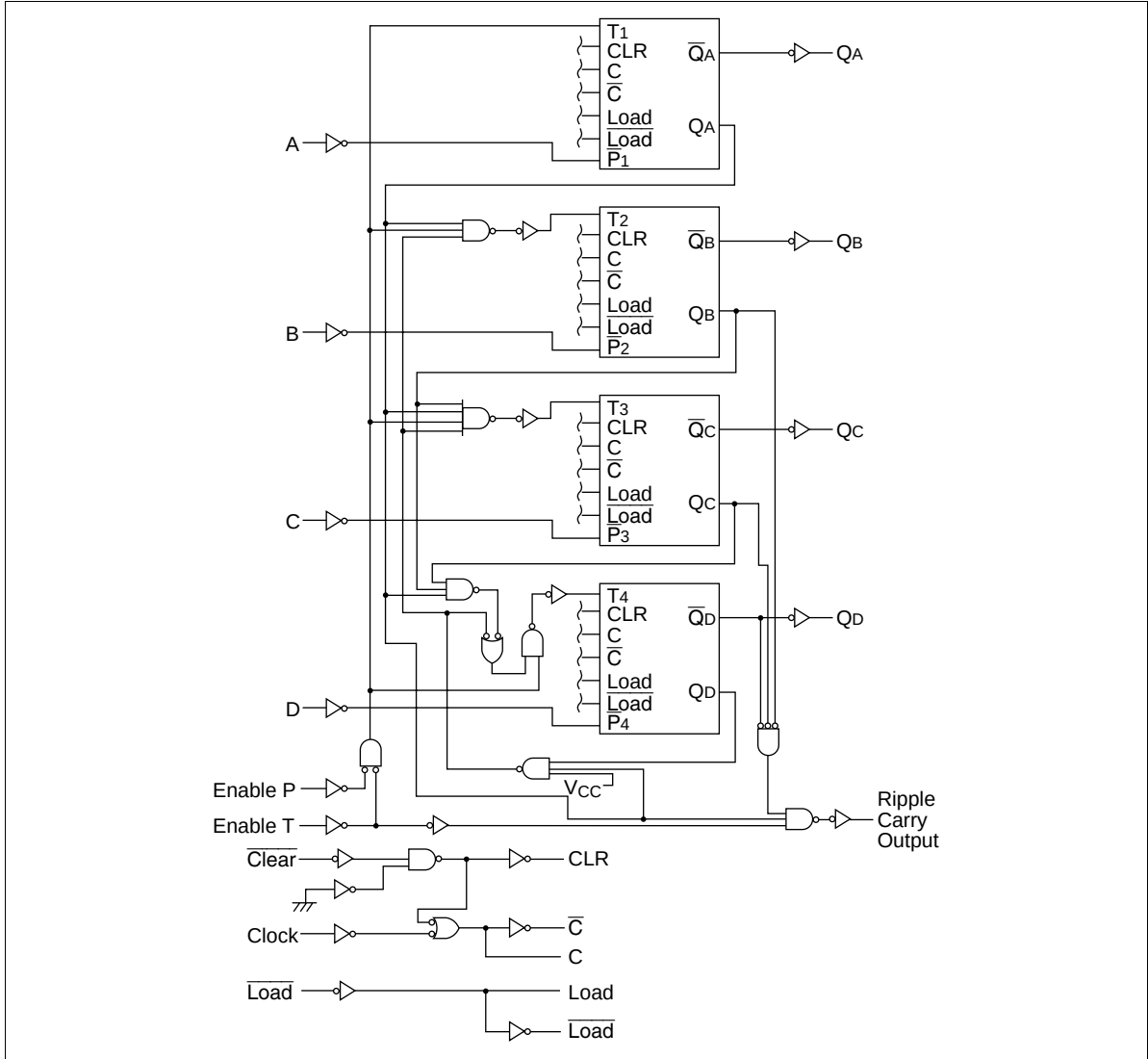
1. Clear outputs to zero.
2. Preset to binary twelve.
3. Count to thirteen, fourteen, fifteen, zero, one and two.
4. Inhibit



Logic Diagram

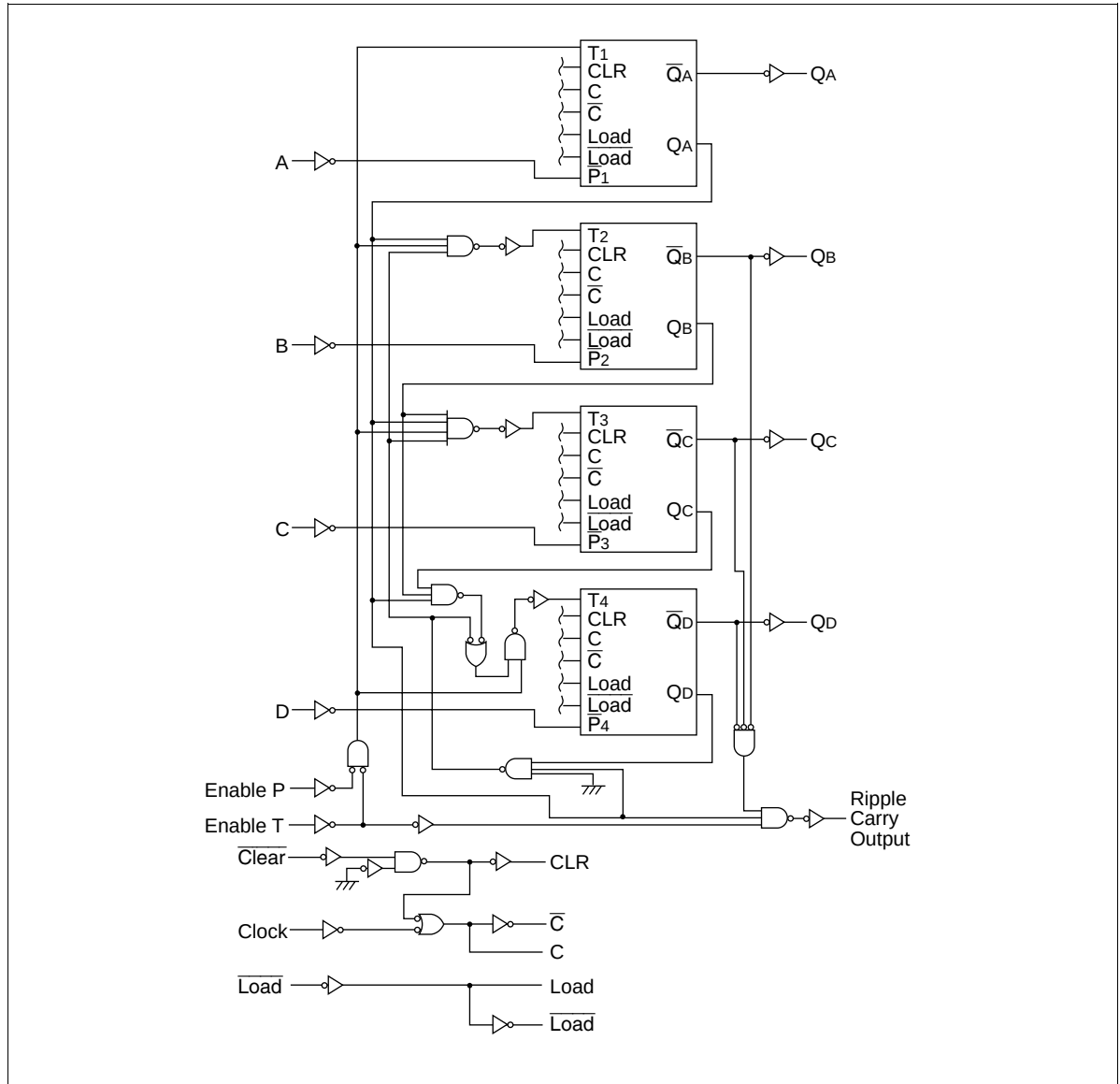
HD74HC160

Decade Counter with Asynchronous Clear



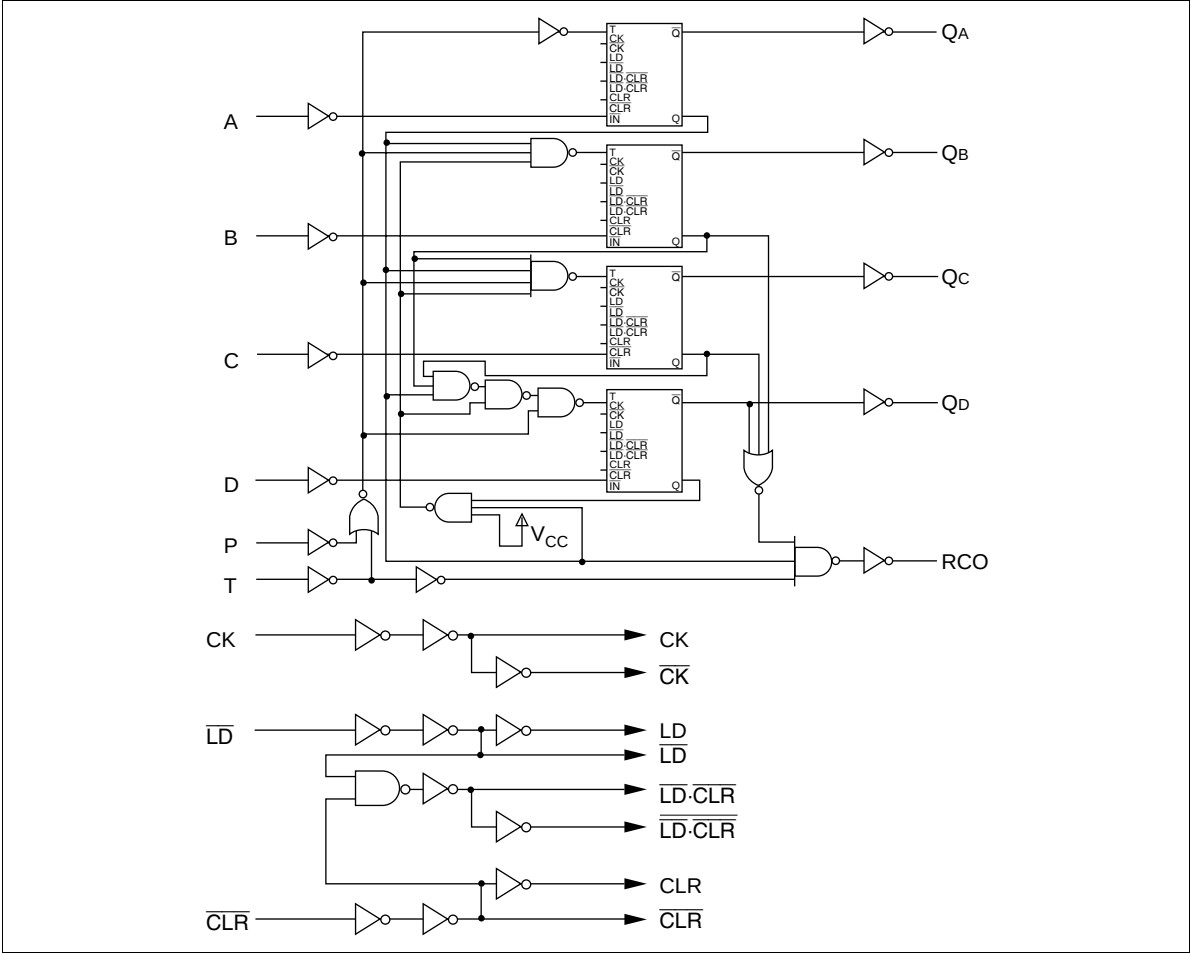
HD74HC161

4-bit Binary Counter with Asynchronous Clear



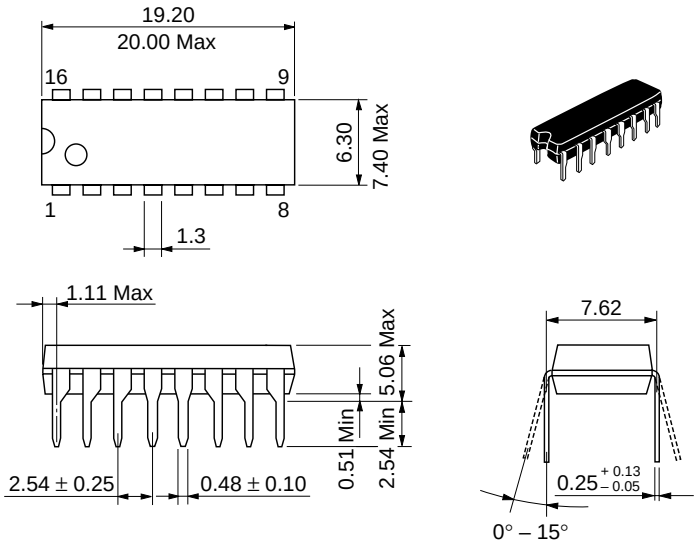
HD74HC162

Decade Counter with Synchronous Clear



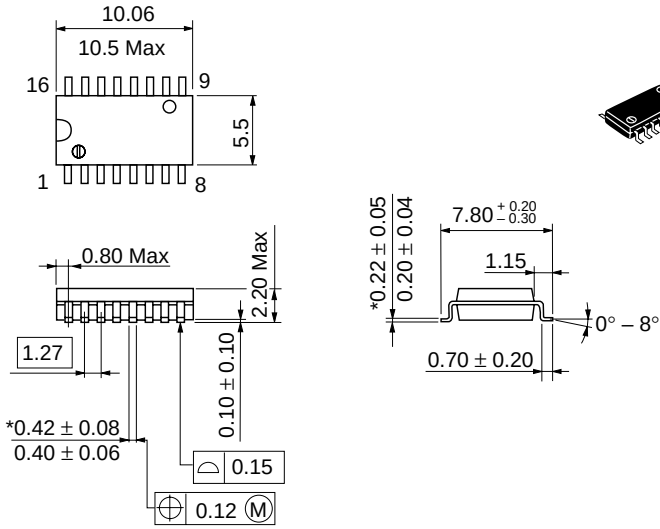
Package Dimensions

Unit: mm



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

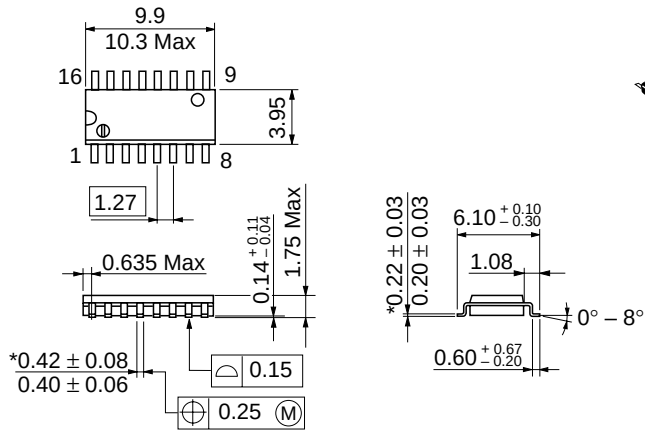
Unit: mm



*Dimension including the plating thickness
Base material dimension

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

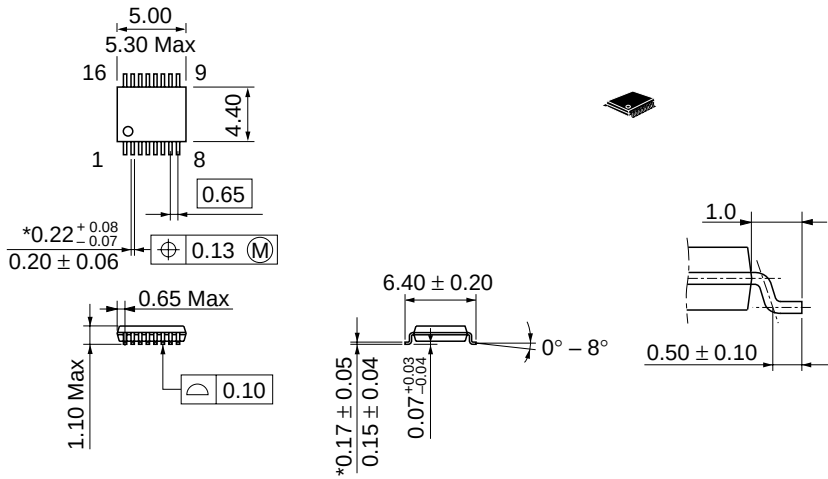
Unit: mm



*Dimension including the plating thickness
Base material dimension

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

Unit: mm



*Dimension including the plating thickness
Base material dimension

Hitachi Code	TTP-16DA
JEDEC	—
EIAJ	—
Mass (reference value)	0.05 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	: http://sicapac.hitachi-asia.com
	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) 585160
--	---

Hitachi Asia Ltd. Hitachi Tower 16 Collyer Quay #20-00, Singapore 049318 Tel: <65>-538-6533/538-8577 Fax: <65>-538-6933/538-3877 URL: http://www.hitachi.com.sg Hitachi Asia Ltd. (Taipei Branch Office) 4/F, No. 167, Tun Hwa North Road, Hung-Kuo Building, Taipei (105), Taiwan Tel: <886>-(2)-2718-3666 Fax: <886>-(2)-2718-8180 Telex: 23222 HAS-TP URL: http://www.hitachi.com.tw
--

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
URL: <http://www.hitachi.com.hk>

Copyright © Hitachi, Ltd., 2000. All rights reserved. Printed in Japan.
Colophon 2.0

HITACHI