

To all our customers

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April 1, 2003

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# 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)



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

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## 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.

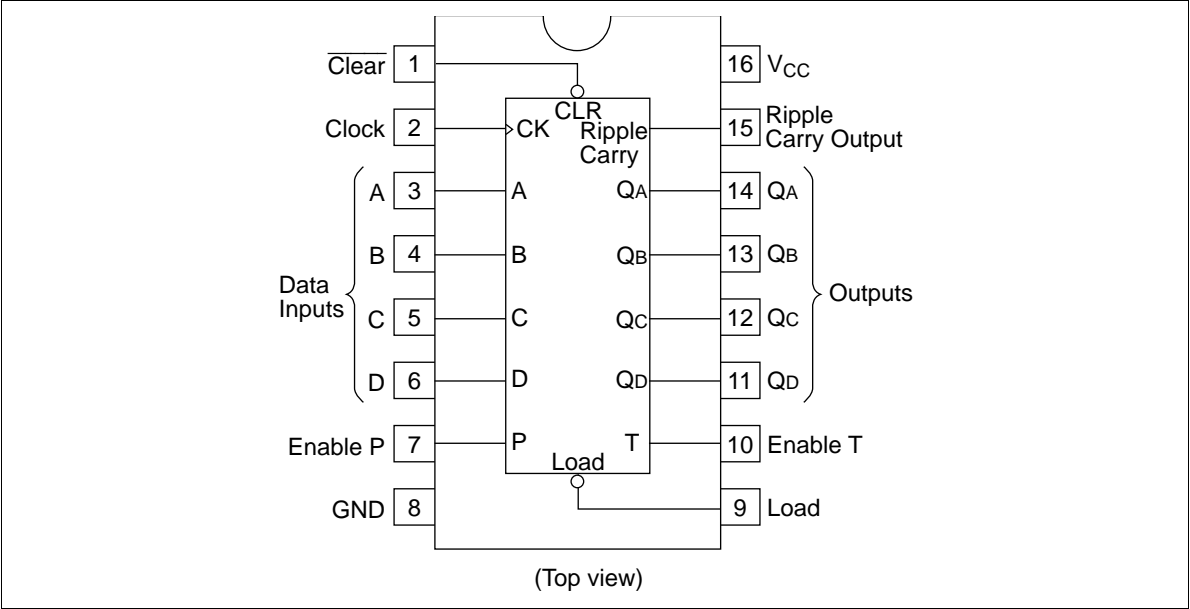
The HD74HC160 and HD74HC161 counters are cleared asynchronously. When the clear is taken low the counter is cleared immediately regardless of the clock.

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  $\mu$ A max
- Low Quiescent Supply Current:  $I_{CC}$  (static) = 4  $\mu$ A max ( $T_a = 25^\circ\text{C}$ )

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 <sub>CC</sub> (V)	Ta = 25°C		Ta = -40 to +85°C		Unit	Test Conditions		
			Min	Typ	Max	Min			Max	
Input voltage	V <sub>IH</sub>	2.0	1.5	—	—	1.5	—	V		
		4.5	3.15	—	—	3.15	—			
		6.0	4.2	—	—	4.2	—			
	V <sub>IL</sub>	2.0	—	—	0.5	—	0.5	V		
		4.5	—	—	1.35	—	1.35			
		6.0	—	—	1.8	—	1.8			
Output voltage	V <sub>OH</sub>	2.0	1.9	2.0	—	1.9	—	V	Vin = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = -20 μA	
		4.5	4.4	4.5	—	4.4	—			
		6.0	5.9	6.0	—	5.9	—			
		4.5	4.18	—	—	4.13	—			I <sub>OH</sub> = -4 mA
		6.0	5.68	—	—	5.63	—			I <sub>OH</sub> = -5.2 mA
	V <sub>OL</sub>	2.0	—	0.0	0.1	—	0.1	V	Vin = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OL</sub> = 20 μA	
		4.5	—	0.0	0.1	—	0.1			
		6.0	—	0.0	0.1	—	0.1			
		4.5	—	—	0.26	—	0.33			I <sub>OL</sub> = 4 mA
		6.0	—	—	0.26	—	0.33			I <sub>OL</sub> = 5.2 mA
Input current	I <sub>in</sub>	6.0	—	—	±0.1	—	±1.0	μA	Vin = V <sub>CC</sub> or GND	
Quiescent supply current	I <sub>CC</sub>	6.0	—	—	4.0	—	40	μA	Vin = V <sub>CC</sub> or GND, I <sub>out</sub> = 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	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	—		Load to Clock
		4.5	25	15	—	31	—		
		6.0	21	—	—	26	—		
		2.0	125	—	—	156	—		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 ( $C_L = 50 \text{ pF}$ , Input  $t_r = t_f = 6 \text{ ns}$ ) (cont)

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

## Function Table

### Count Enable/Disable

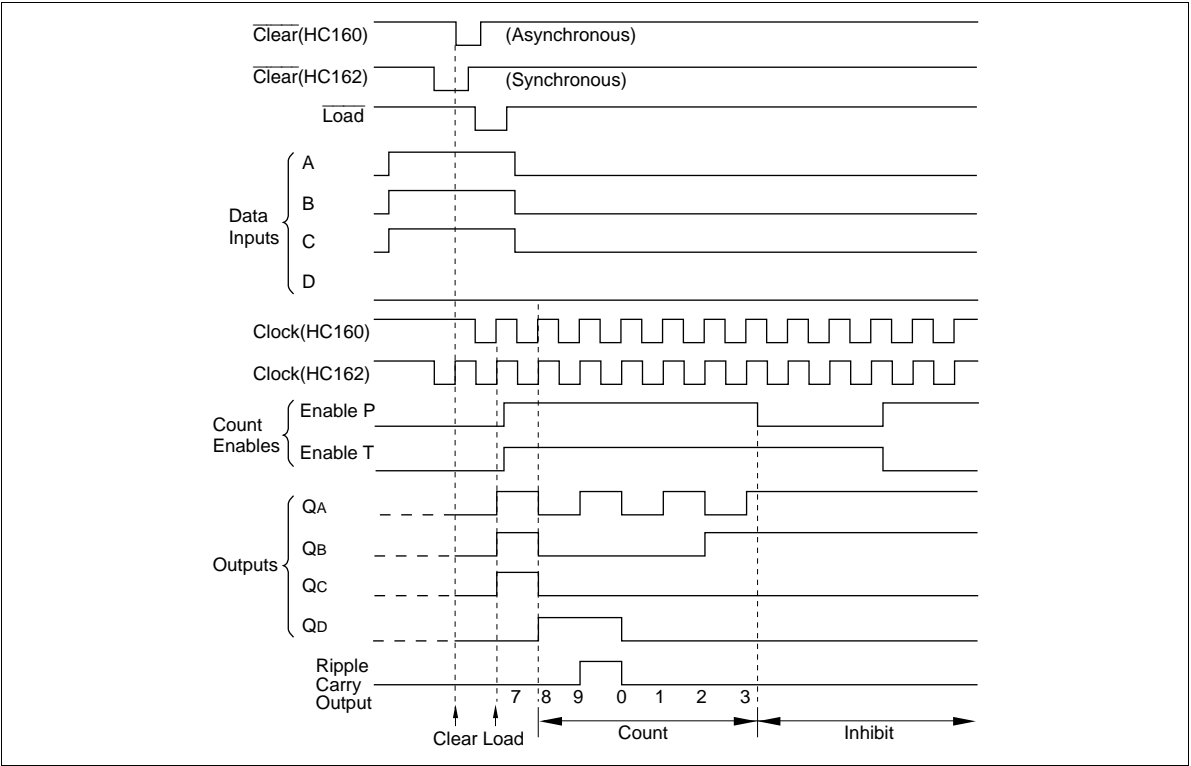
Control Inputs			Result at Outputs	
$\overline{\text{Load}}$	Enable P	Enable T	$Q_A$ to $Q_D$	Ripple Carry Output
H	H	H	Count	High when $Q_A$ to $Q_D$ are maximum
L	H	H	No count	
X	L	H	No count	High when $Q_A$ to $Q_D$ are maximum
X	H	L	No count	L
X	L	L	No count	L

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

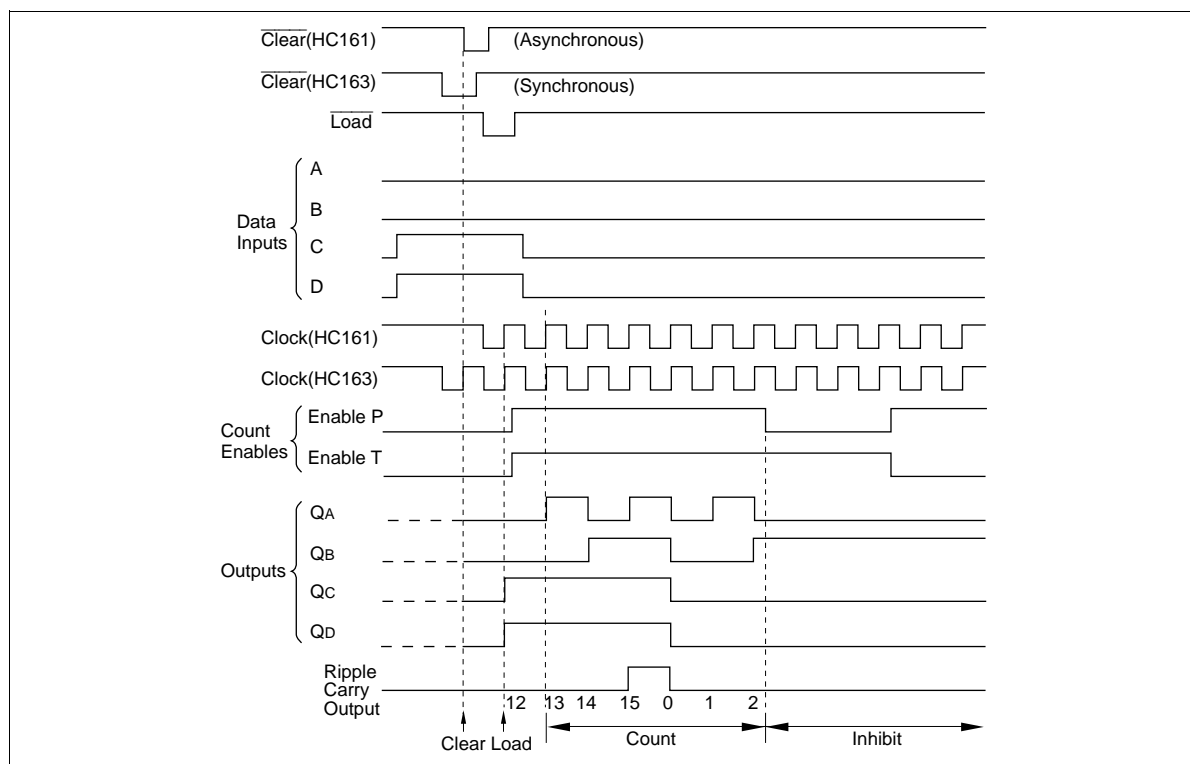




## HD74HC161/HD74HC163

Sequence illustrated in waveforms.

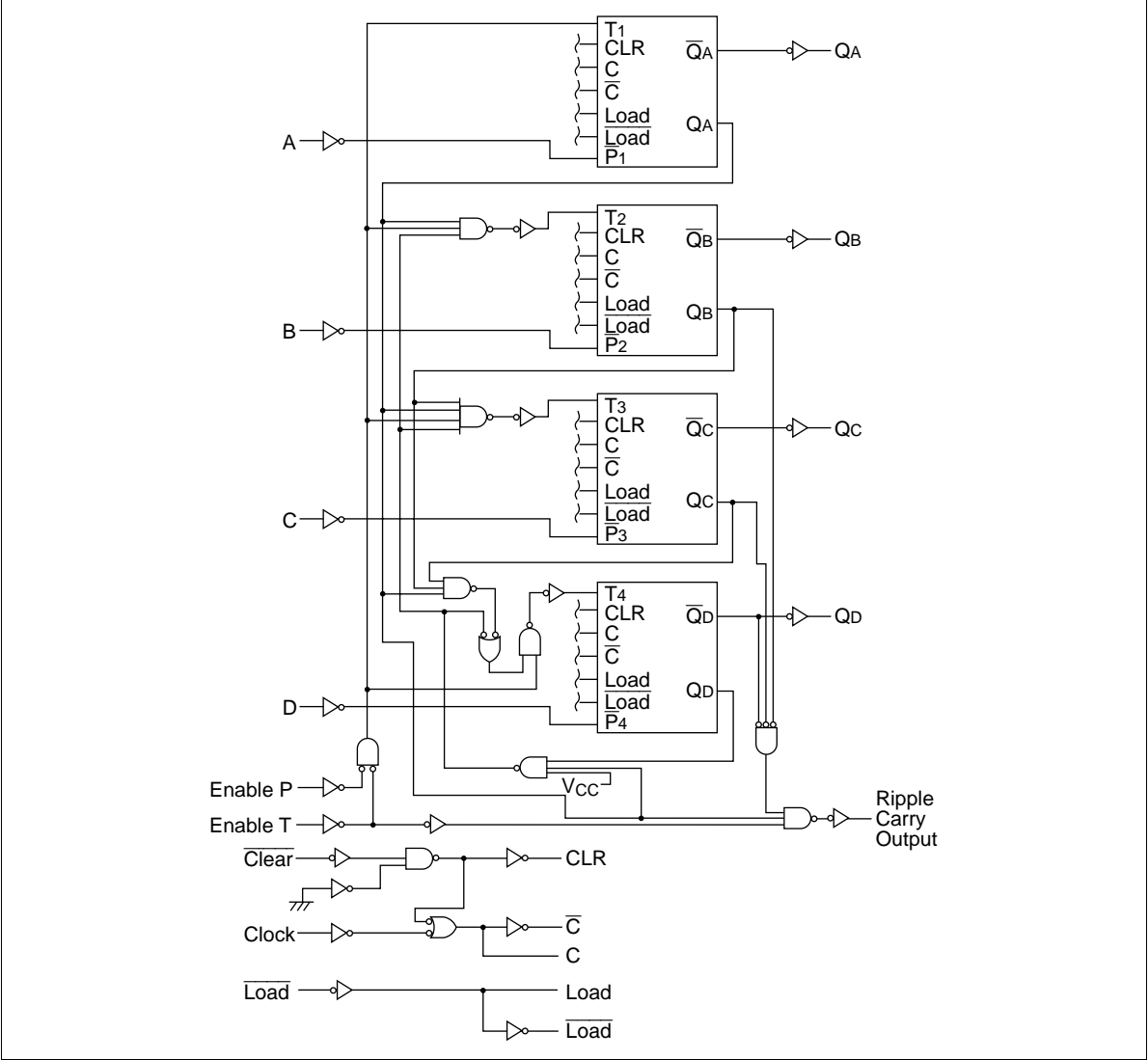
1. Clear outputs to zero.
2. Preset to binary twelve.
3. Count to thirteen, fourteen, fifteen, zero, one and two.
4. Inhibit



Logic Diagram

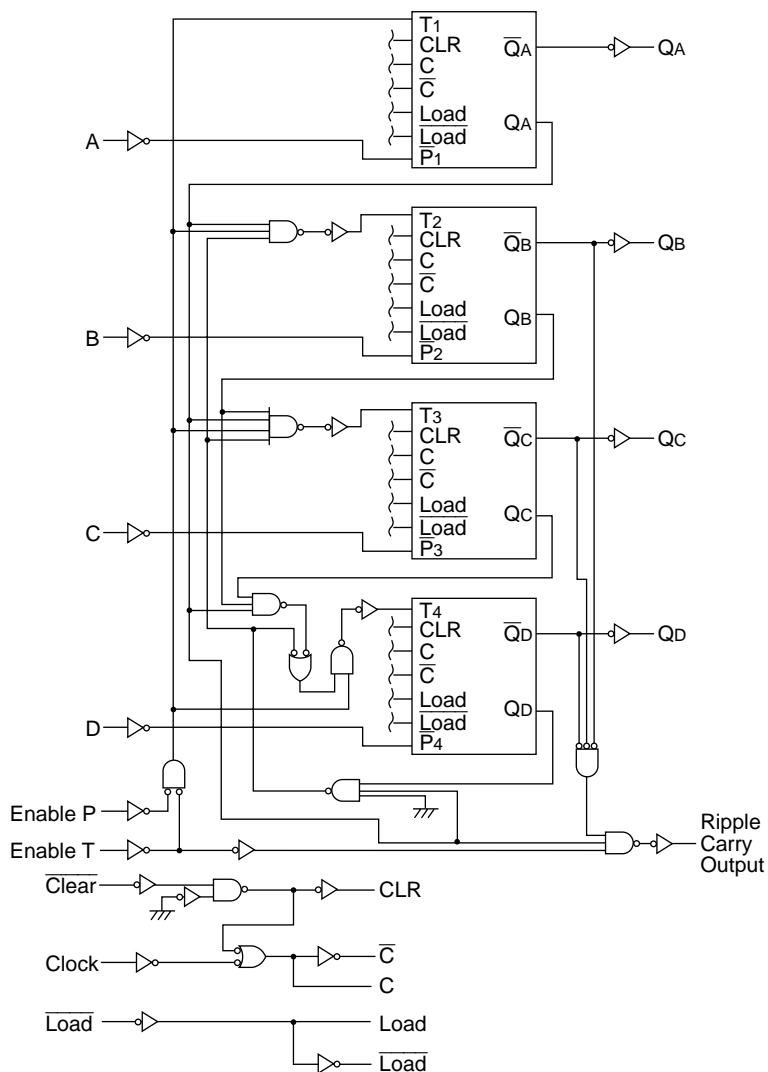
HD74HC160

Decade Counter with Asynchronous Clear



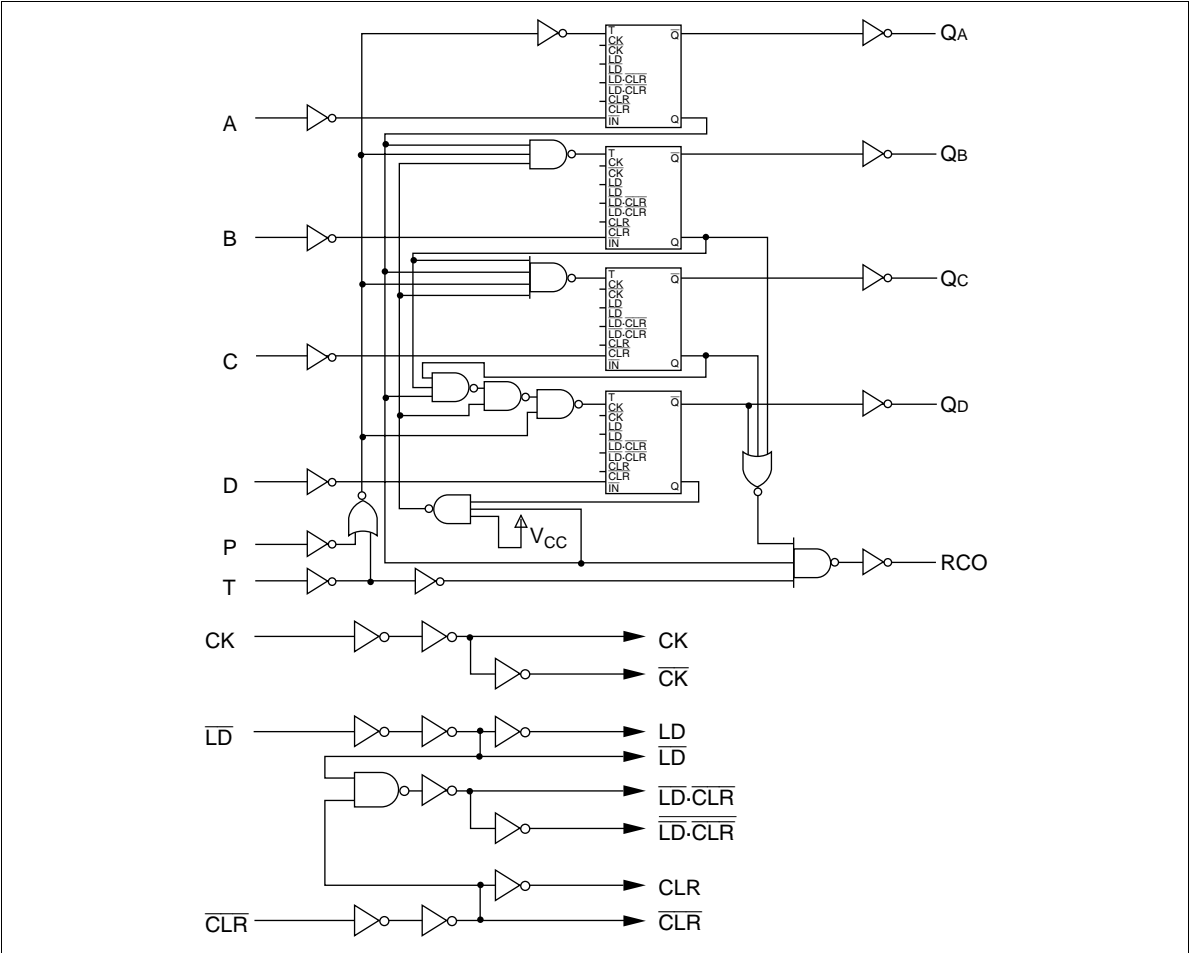
# HD74HC161

## 4-bit Binary Counter with Asynchronous Clear



HD74HC162

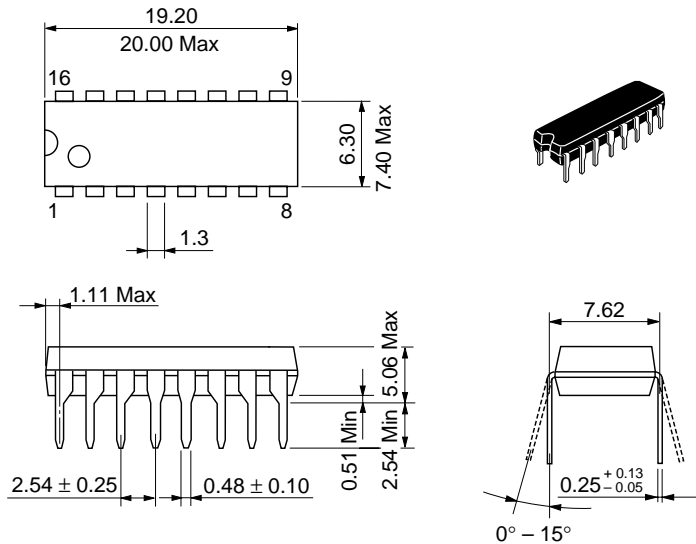
Decade Counter with Synchronous Clear





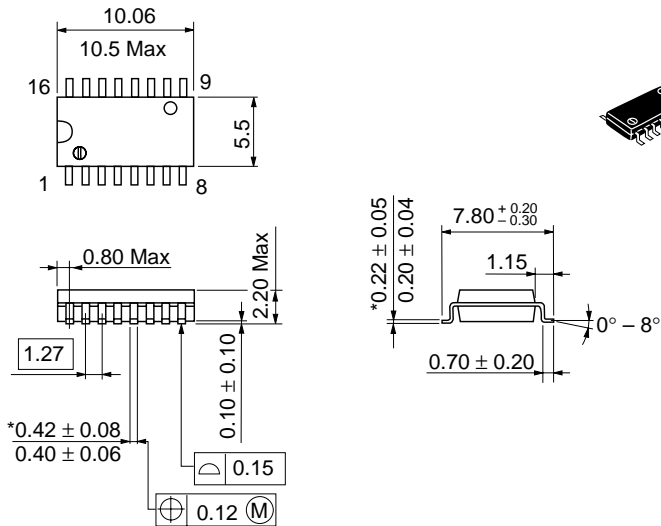
Package Dimensions

Unit: mm



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

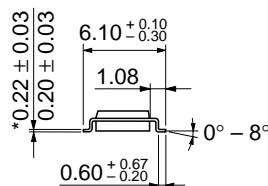
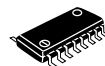
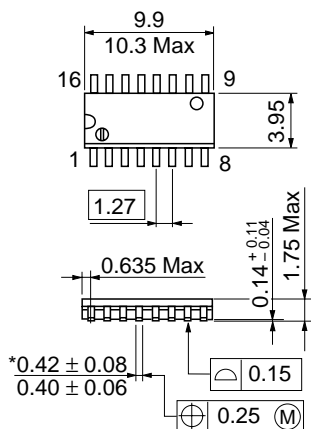
Unit: mm



\*Dimension including the plating thickness  
Base material dimension

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

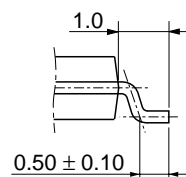
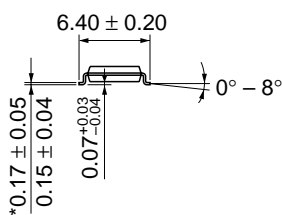
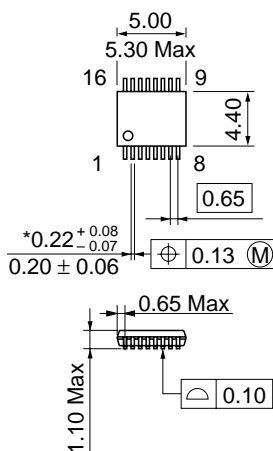
Unit: mm



\*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

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# HITACHI

**Hitachi, Ltd.**

Semiconductor &amp; 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	NorthAmerica	: <a href="http://semiconductor.hitachi.com/">http://semiconductor.hitachi.com/</a>
	Europe	: <a href="http://www.hitachi-eu.com/hel/ecg">http://www.hitachi-eu.com/hel/ecg</a>
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**For further information write to:**Hitachi Semiconductor  
(America) Inc.179 East Tasman Drive,  
San Jose, CA 95134

Tel: &lt;1&gt; (408) 433-1990

Fax: &lt;1&gt; (408) 433-0223

Hitachi Europe GmbH  
Electronic Components GroupDornacher Straße 3  
D-85622 Feldkirchen, Munich

Germany

Tel: &lt;49&gt; (89) 9 9180-0

Fax: &lt;49&gt; (89) 9 29 30 00

Hitachi Europe Ltd.

Electronic Components Group.

Whitebrook Park

Lower Cookham Road

Maidenhead

Berkshire SL6 8YA, United Kingdom

Tel: &lt;44&gt; (1628) 585000

Fax: &lt;44&gt; (1628) 585160

Hitachi Asia Ltd.

Hitachi Tower

16 Collyer Quay #20-00,

Singapore 049318

Tel: &lt;65&gt;-538-6533/538-8577

Fax: &lt;65&gt;-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: &lt;886&gt;-(2)-2718-3666

Fax: &lt;886&gt;-(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: &lt;852&gt;-(2)-735-9218

Fax: &lt;852&gt;-(2)-730-0281

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