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)

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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 thte 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 are 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 µA max

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- Low Quiescent Supply Current: I_{CC} (static) = 4 µA max (Ta = 25°C)

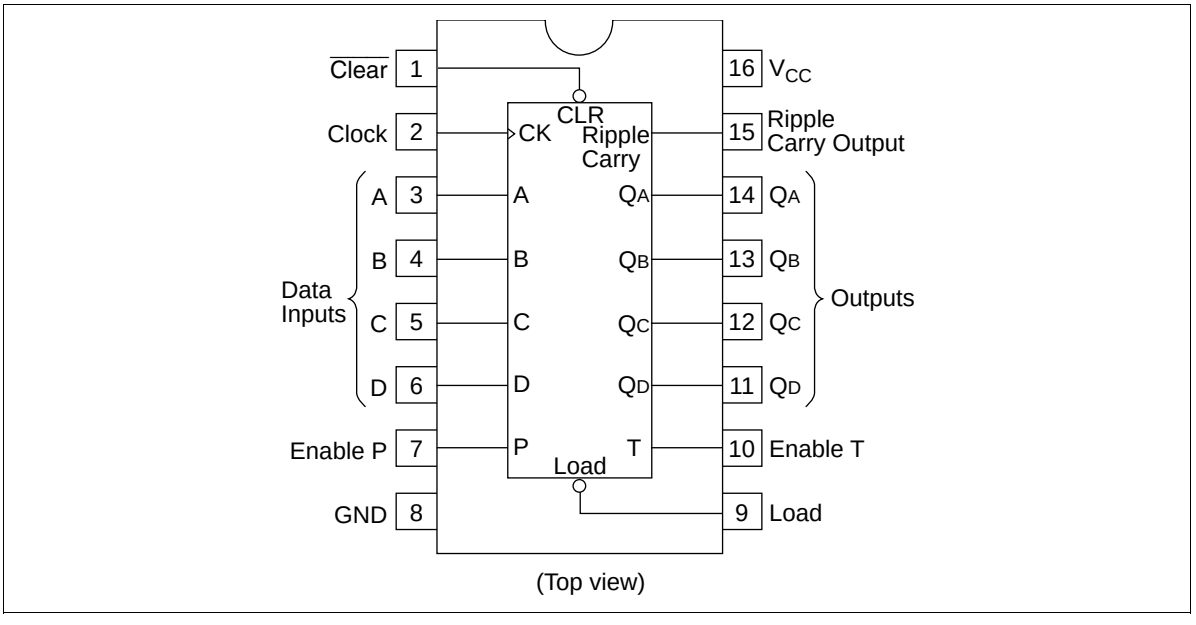
Function Table

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	HD74HC160P	HD74HC161P
Synchronous clear	HD74HC162P	HD74HC163P

Pin Arrangement



DC Characteristics

			Ta = 25°C			Ta = –40 to +85°C			
Item	**Symbol**	**V_{CC} (V)**	**Min**	**Typ**	**Max**	**Min**	**Max**	**Unit**	**Test Conditions**
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	—		I_{OH} = –4 mA
		6.0	5.68	—	—	5.63	—		I_{OH} = –5.2 mA
	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		I_{OL} = 4 mA
		6.0	—	—	0.26	—	0.33		I_{OL} = 5.2 mA
Input current	Iin	6.0	—	—	±0.1	—	±1.0	µA	Vin = V_{CC} or GND
Quiescent supply current	I_{CC}	6.0	—	—	4.0	—	40	µA	Vin = V_{CC} or GND, Iout = 0 µA

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

			Ta = 25°C			Ta = –40 to +85°C			
Item	**Symbol**	**V_{cc} (V)**	**Min**	**Typ**	**Max**	**Min**	**Max**	**Unit**	**Test Conditions**
Maximum clock frequency	f_{max}	2.0	—	—	5	—	4	MHz	
		4.5	—	—	25	—	20		
		6.0	—	—	29	—	23		
Propagation delay time	t_{PLH} t_{PHL}	2.0	—	—	160	—	200	ns	Clock to Q
		4.5	—	18	32	—	40		
		6.0	—	—	27	—	34		
		2.0	—	—	225	—	280	ns	$\overline{\text{Clear}}$ to Q
		4.5	—	23	45	—	56		(HC160, HC161 only)
		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
		4.5	25	—	—	31	—		(HC162, HC163 only)
		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)

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

Function Table

Count Enable/Disable

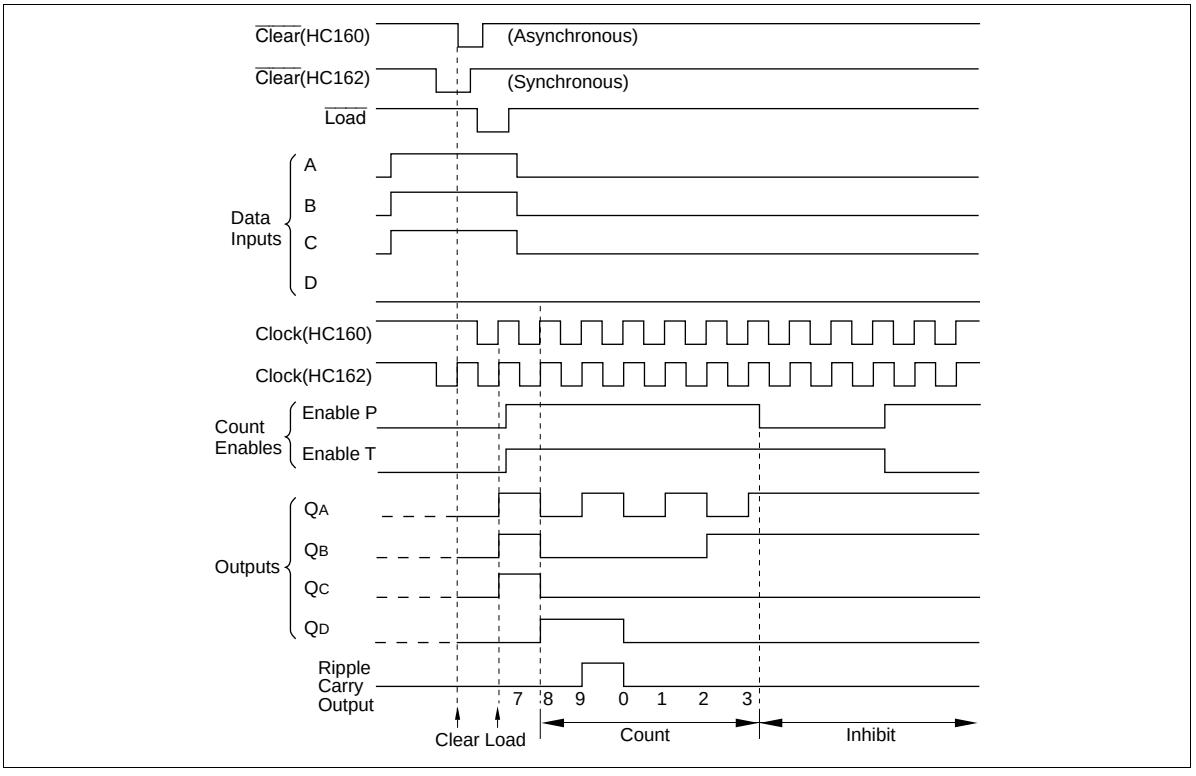
Control Inputs			**Result at Outputs**	
$\overline{Load}$	**Enable P**	**Enable T**	**Q_A to Q_D**	**Ripple Carry Output**
H	H	H	Count	High when Q_A to Q_D are maximum
L	H	H	No count	
X	L	H	No count	High when Q_A to Q_D are maximum
X	H	L	No count	L
X	L	L	No count	L

Timing Diagram

HD74HC160/HD74HC162

Sequence illustrated in waveforms.

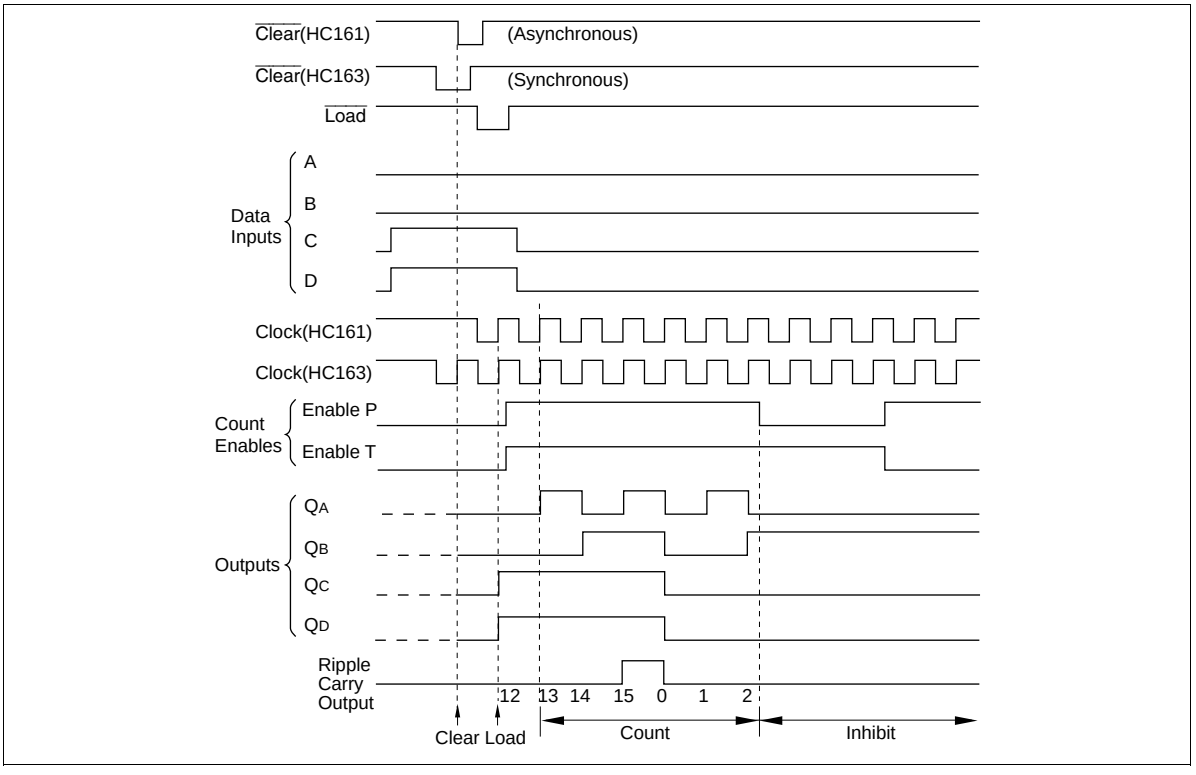
1. Clear outputs to zero.
2. Preset to BCD seven.
3. Count to eight, nine, zero, one, two and three.
4. Inhibit



HD74HC161/HD74HC163

Sequence illustrated in waveforms.

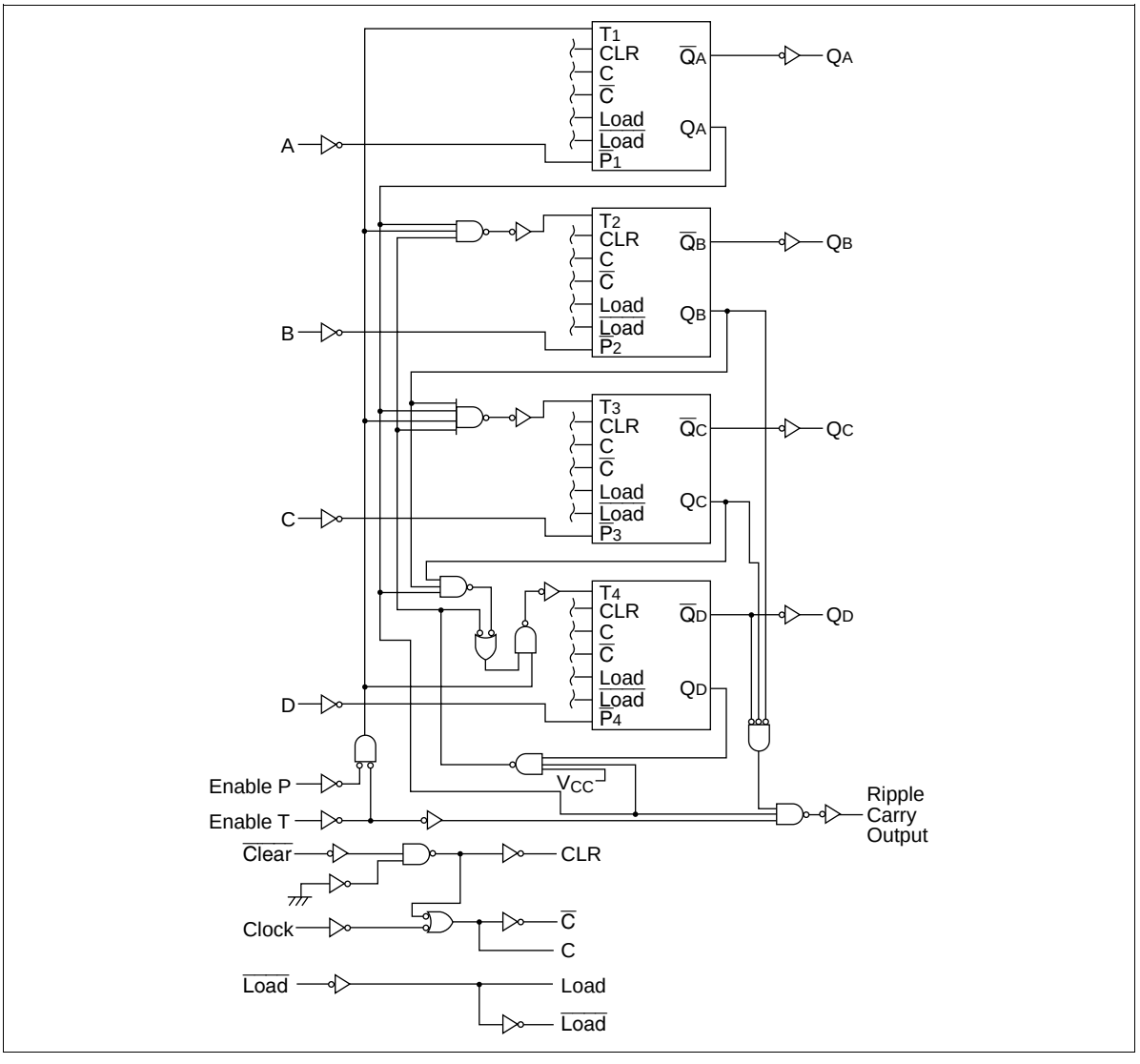
1. Clear outputs to zero.
2. Preset to binary twelve.
3. Count to thirteen, fourteen, fifteen, zero, one and two.
4. Inhibit



Logic Diagram

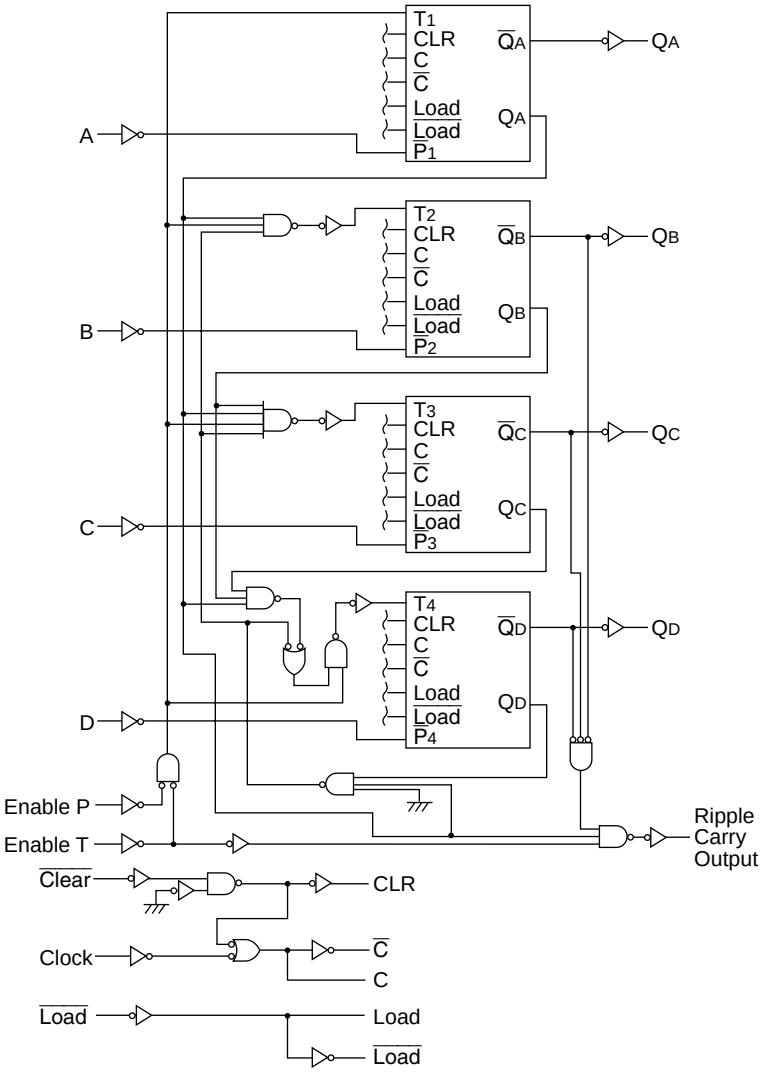
HD74HC160

Decade Counter with Asynchronous Clear



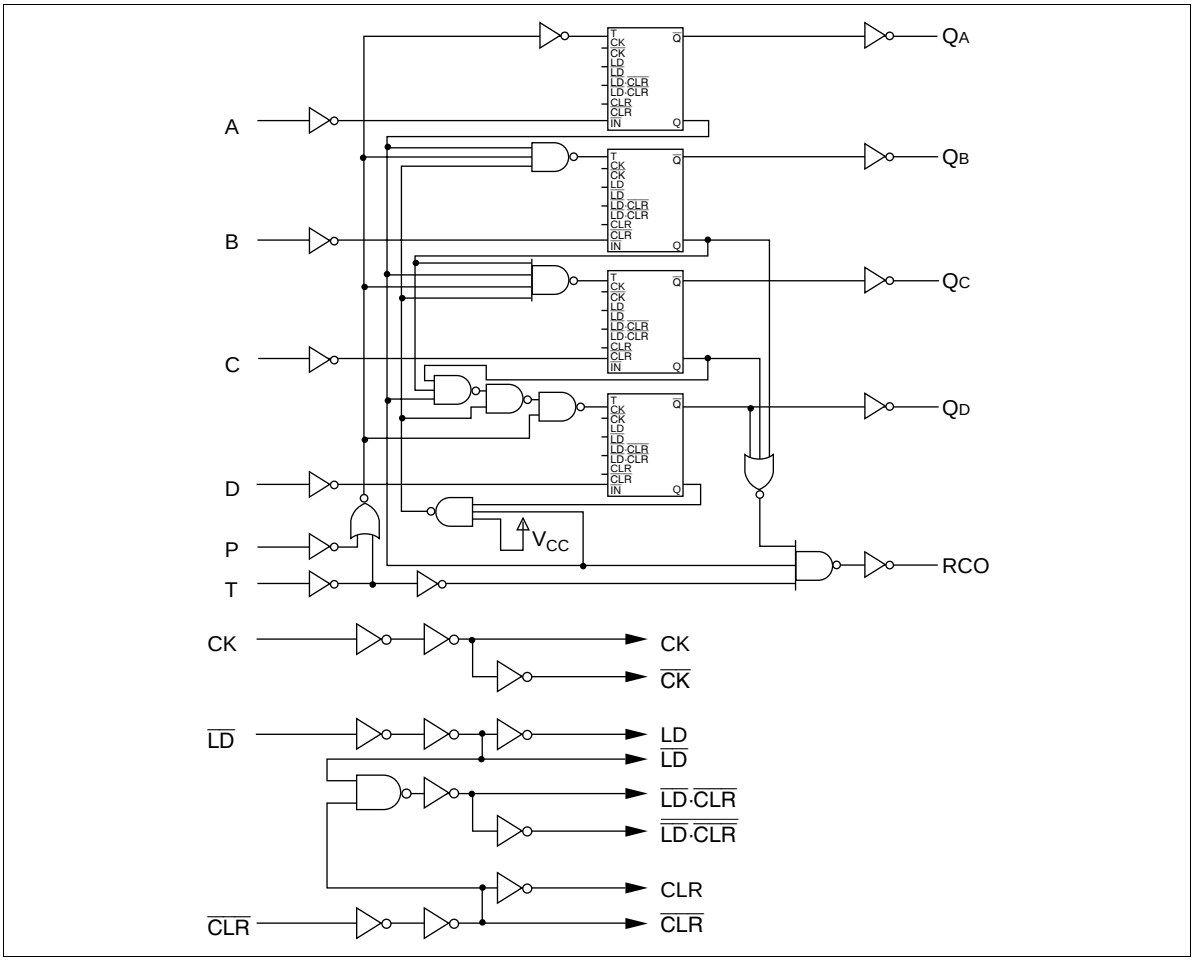
HD74HC161

4-bit Binary Counter with Asynchronous Clear



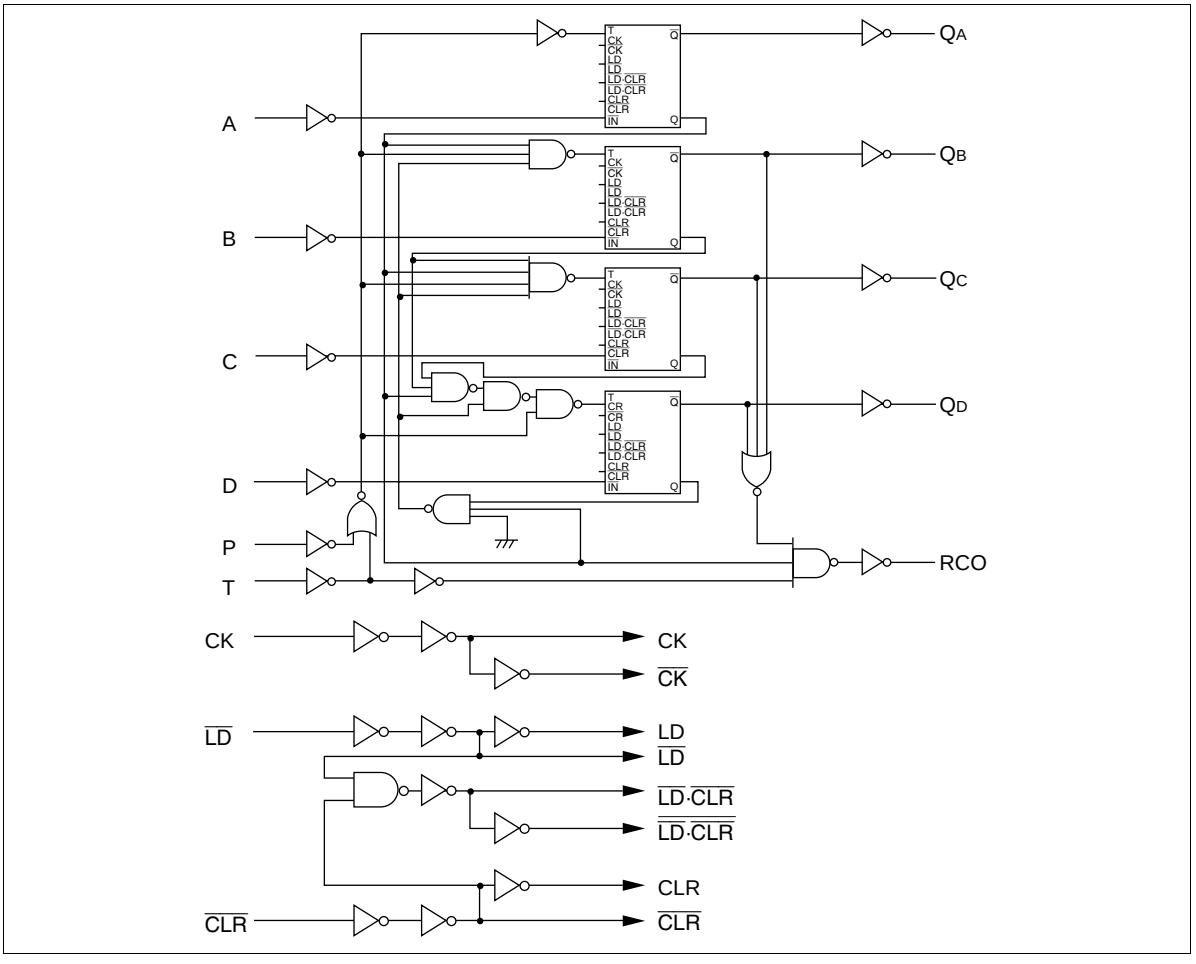
HD74HC162

Decade Counter with Synchronous Clear

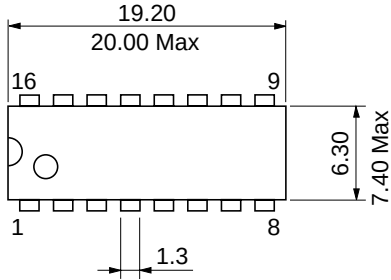


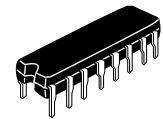
HD74HC163

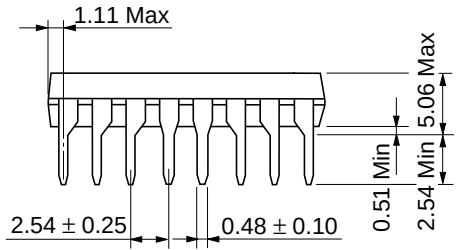
4-bit Binary Counter with Synchronous Clear

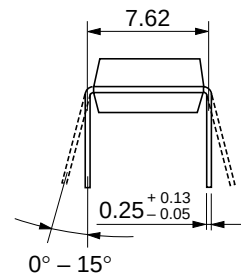


Unit: mm



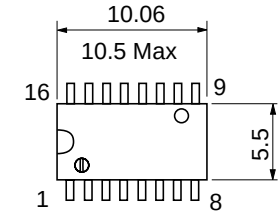


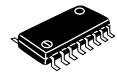


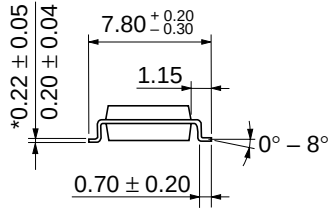


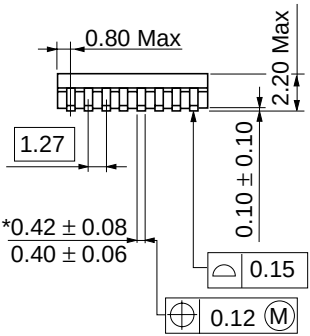
Hitachi Code	DP-16
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	1.07 g

Unit: mm





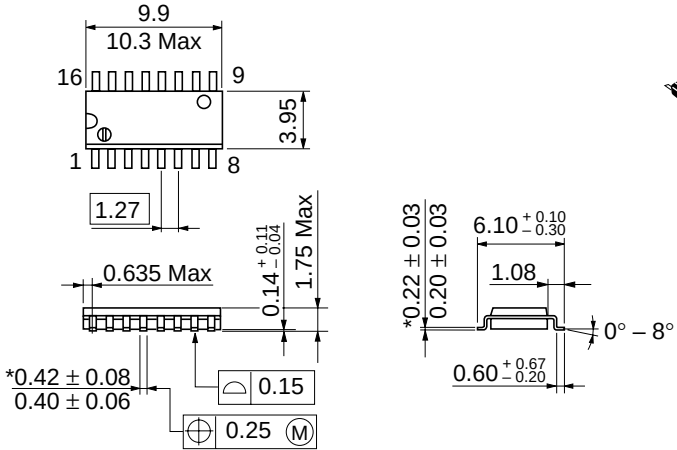


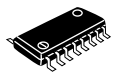


*Dimension including the plating thickness
Base material dimension

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

Unit: mm

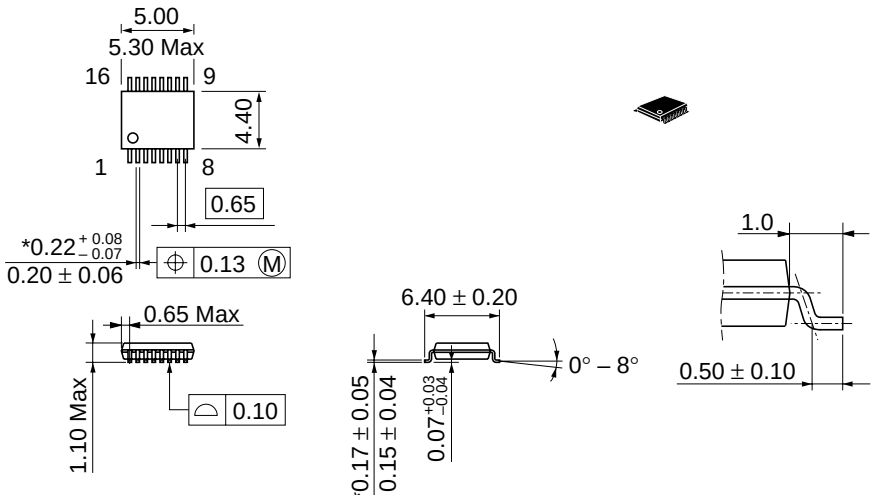




Hitachi Code	FP-16DN
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	0.15 g

*Dimension including the plating thickness
Base material dimension

Unit: mm



Hitachi Code	TTP-16DA
JEDEC	—
EIAJ	—
Weight (reference value)	0.05 g

*Dimension including the plating thickness
Base material dimension