

To our customers,

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## Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: <http://www.renesas.com>

April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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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)

REJ03D0579-0200  
(Previous ADE-205-455)  
Rev.2.00  
Oct 11, 2005

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

• Ordering Information

Part Name	Package Type	Package Code (Previous Code)	Package Abbreviation	Taping Abbreviation (Quantity)
HD74HC160P HD74HC161P HD74HC162P HD74HC163P	DILP-16 pin	PRDP0016AE-B (DP-16FV)	P	—
HD74HC160FPEL HD74HC161FPEL HD74HC162FPEL HD74HC163FPEL	SOP-16 pin (JEITA)	PRSP0016DH-B (FP-16DAV)	FP	EL (2,000 pcs/reel)
HD74HC160RPEL HD74HC162RPEL HD74HC163RPEL	SOP-16 pin (JEDEC)	PRSP0016DG-A (FP-16DNV)	RP	EL (2,500 pcs/reel)
HD74HC161TELL	TSSOP-16 pin	PTSP0016JB-A (TTP-16DAV)	T	ELL (2,000 pcs/reel)

Note: Please consult the sales office for the above package availability.

Function Table

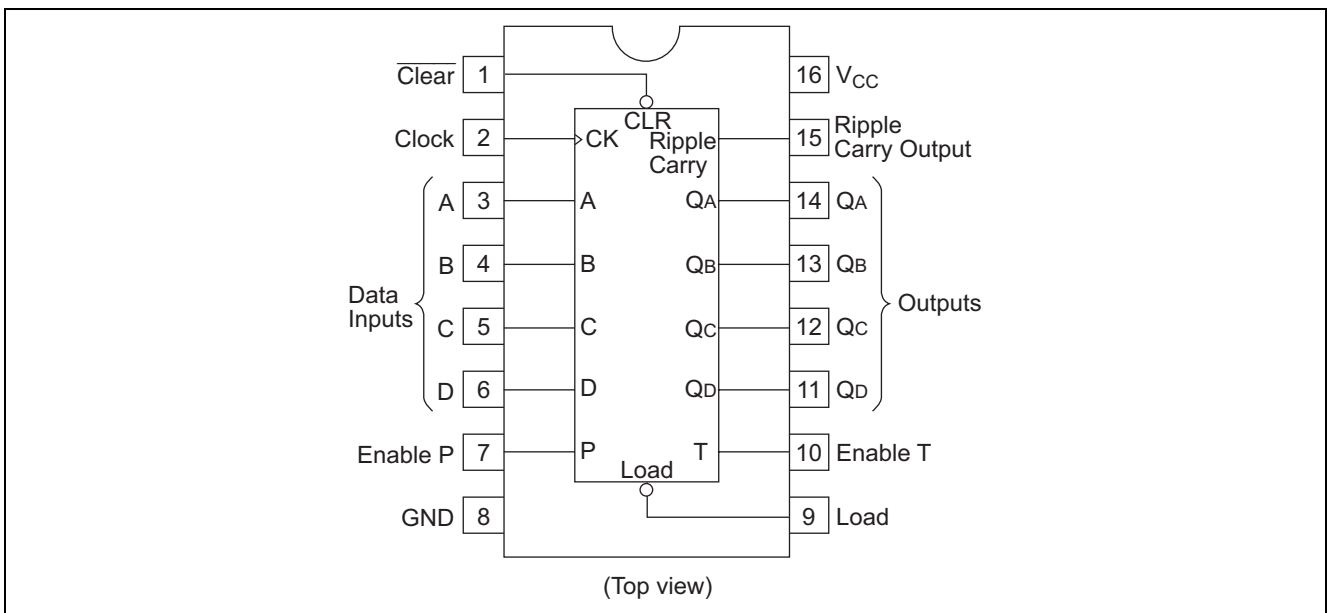
Clock	Inputs				Outputs
	Clear*1	Load	Enable P	Enable T	Q <sub>n</sub>
	L	X	X	X	Reset-clear
	H	L	X	X	Load input data
	H	H	H	H	Count
	H	H	L	X	No count
	H	H	X	L	No count

H : High level L : Low level X : Irrelevant

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

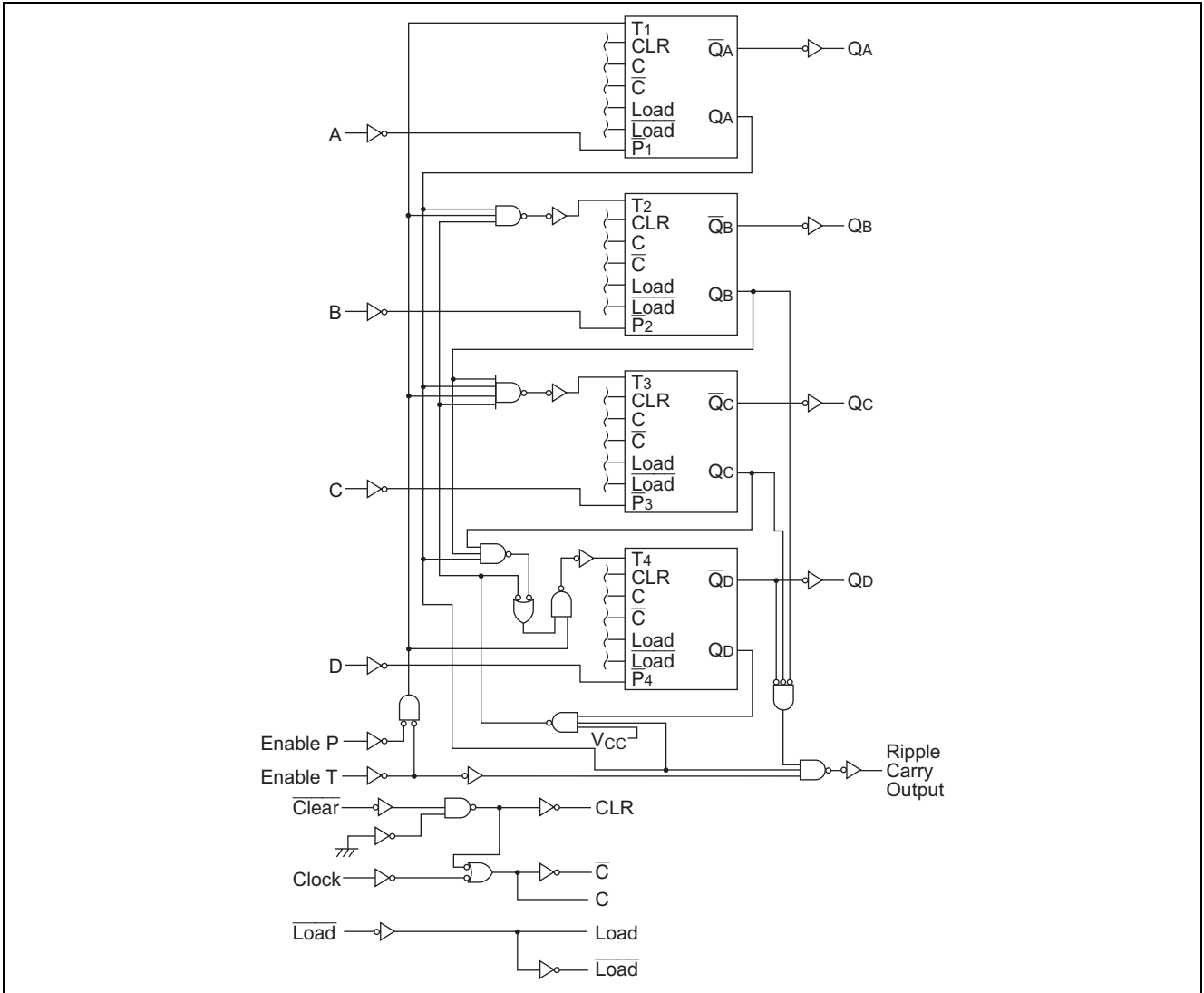
Pin Arrangement



## Logic Diagram

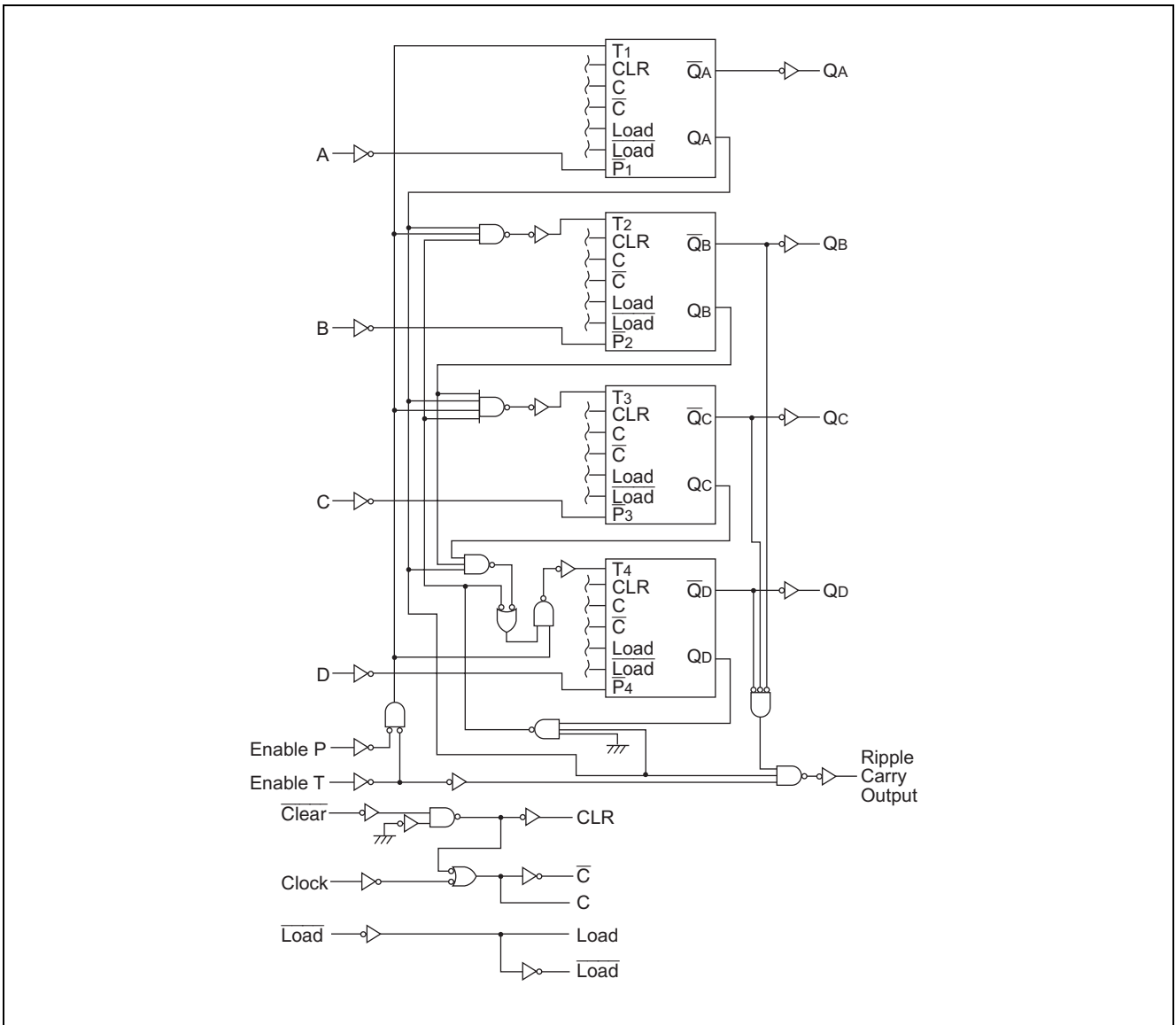
### HD74HC160

Decade Counter with Asynchronous Clear



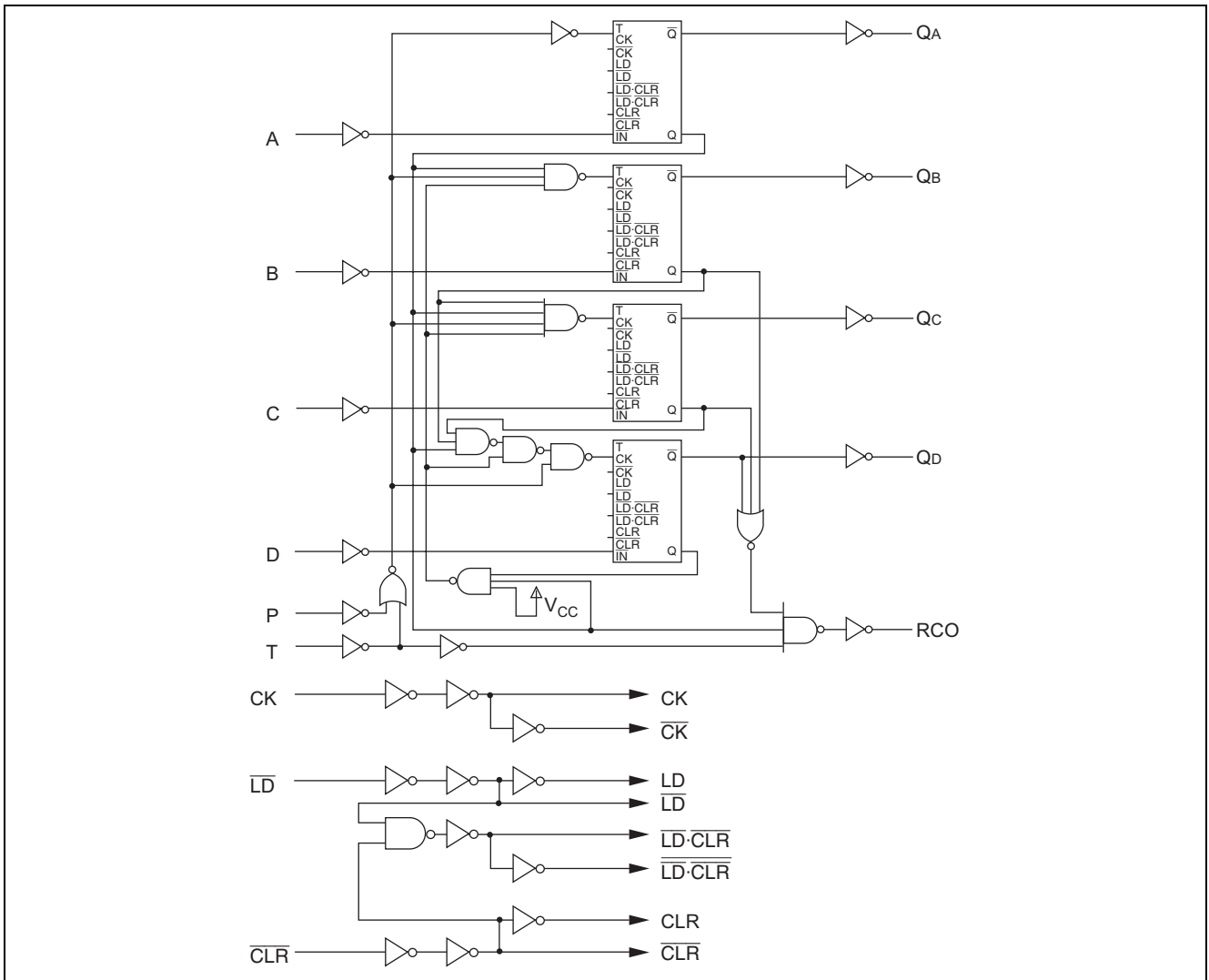
**HD74HC161**

4-bit Binary Counter with Asynchronous Clear



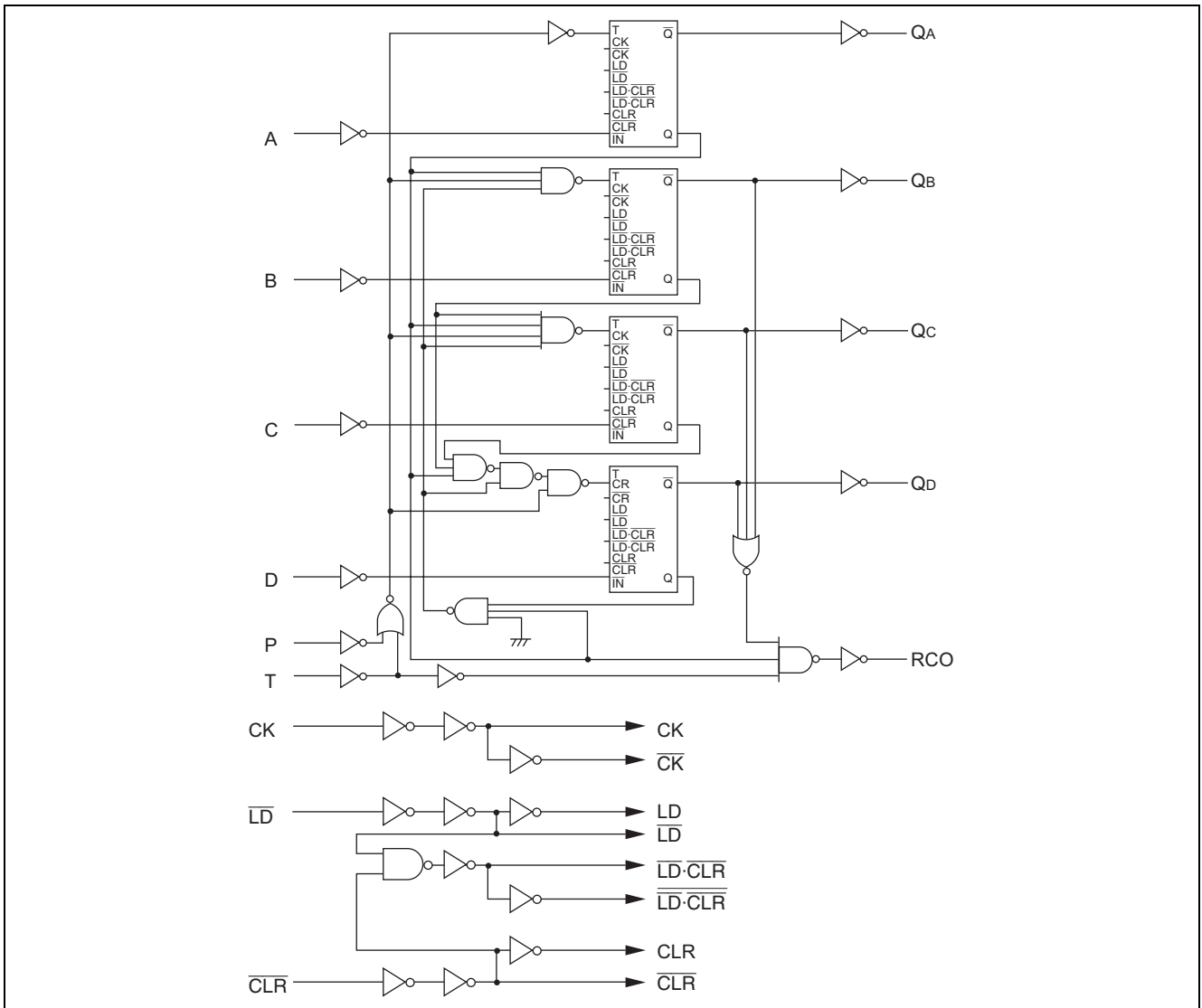
**HD74HC162**

Decade Counter with Synchronous Clear



**HD74HC163**

4-bit Binary Counter with Synchronous Clear



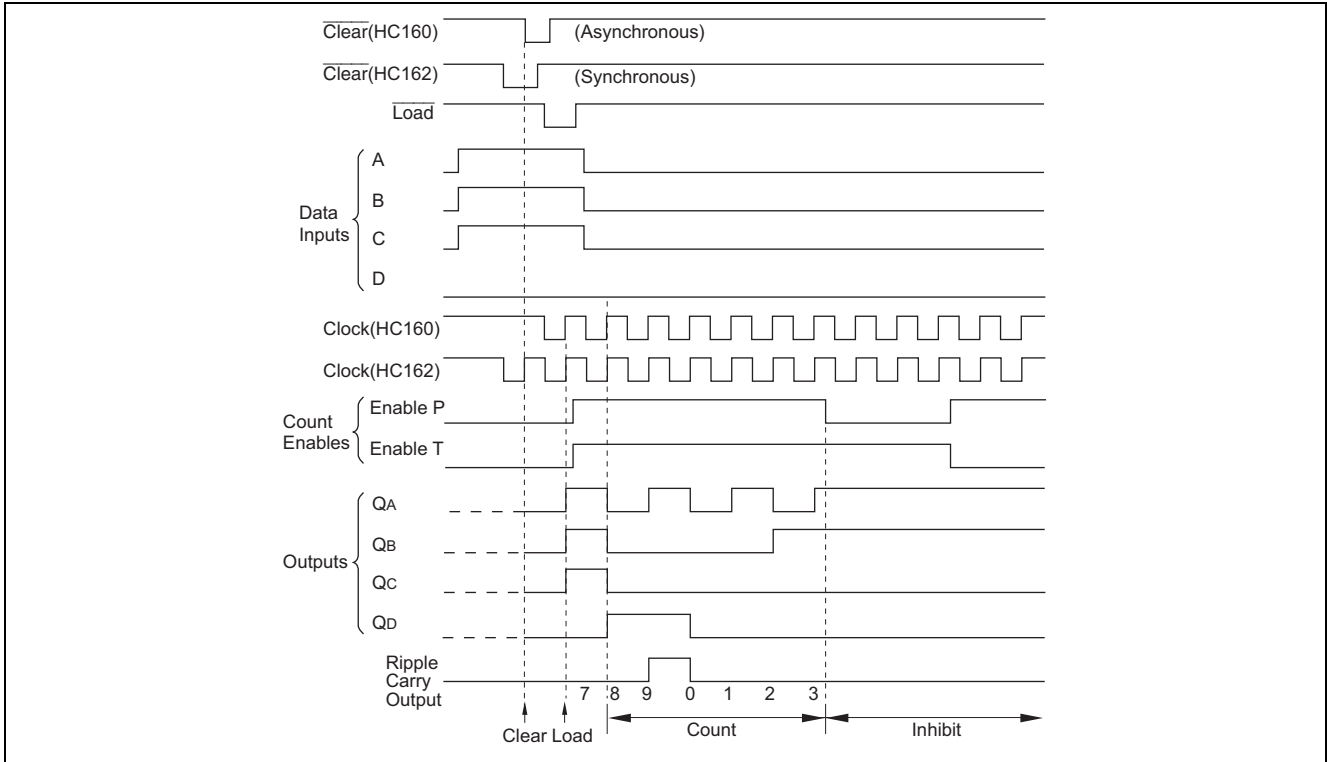


## Timing Diagram

### HD74HC160/HD74HC162

Sequence illustrated in waveforms.

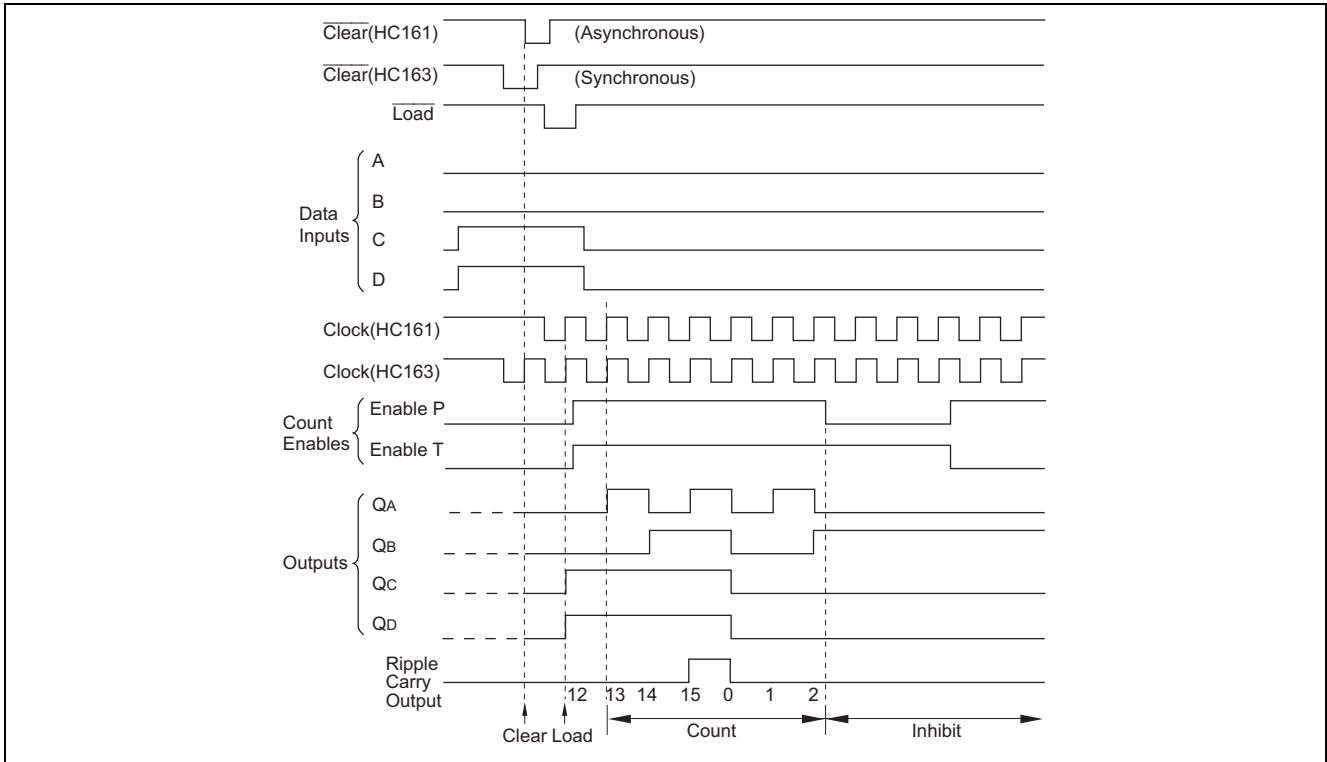
1. Clear outputs to zero.
2. Preset to BCD seven.
3. Count to eight, nine, zero, one, two and three.
4. Inhibit



**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



## Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5 to +7.0	V
Input voltage	$V_{IN}$	-0.5 to $V_{CC} + 0.5$	V
Output voltage	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	V
Output current	$I_{OUT}$	$\pm 25$	mA
DC current drain per $V_{CC}$ , GND	$I_{CC}$ , $I_{GND}$	$\pm 50$	mA
DC input diode current	$I_{IK}$	$\pm 20$	mA
DC output diode current	$I_{OK}$	$\pm 20$	mA
Power dissipation per package	$P_T$	500	mW
Storage temperature	$T_{stg}$	-65 to +150	°C

Note: The absolute maximum ratings are values, which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

## Recommended Operating Conditions

Item	Symbol	Ratings	Unit	Conditions
Supply voltage	$V_{CC}$	2 to 6	V	
Input / Output voltage	$V_{IN}$ , $V_{OUT}$	0 to $V_{CC}$	V	
Operating temperature	$T_a$	-40 to 85	°C	
Input rise / fall time <sup>*1</sup>	$t_r$ , $t_f$	0 to 1000	ns	$V_{CC} = 2.0$ V
		0 to 500		$V_{CC} = 4.5$ V
		0 to 400		$V_{CC} = 6.0$ V

Note: 1. This item guarantees maximum limit when one input switches.

Waveform: Refer to test circuit of switching characteristics.

## Electrical Characteristics

Item	Symbol	$V_{CC}$ (V)	$T_a = 25^\circ\text{C}$			$T_a = -40$ to $+85^\circ\text{C}$		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	$V_{in} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20$ $\mu\text{A}$
		4.5	4.4	4.5	—	4.4	—			$I_{OH} = -4$ mA
		6.0	5.9	6.0	—	5.9	—			$I_{OH} = -5.2$ mA
		4.5	4.18	—	—	4.13	—			
		6.0	5.68	—	—	5.63	—			
	$V_{OL}$	2.0	—	0.0	0.1	—	0.1	V	$V_{in} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20$ $\mu\text{A}$
		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	$I_{in}$	6.0	—	—	$\pm 0.1$	—	$\pm 1.0$	$\mu\text{A}$	$V_{in} = V_{CC}$ or GND	
Quiescent supply current	$I_{CC}$	6.0	—	—	4.0	—	40	$\mu\text{A}$	$V_{in} = V_{CC}$ or GND, $I_{out} = 0$ $\mu\text{A}$	

**Switching Characteristics** ( $C_L = 50 \text{ pF}$ , Input  $t_r = t_f = 6 \text{ ns}$ )

Item	Symbol	$V_{CC}$ (V)	$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } +85^\circ\text{C}$		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	$t_{PLH}, t_{PHL}$	2.0	—	—	160	—	200	ns	Clock to Q		
		4.5	—	18	32	—	40				
		6.0	—	—	27	—	34				
				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	—	ns	Load to Clock
				4.5	25	15	—	31	—		
				6.0	21	—	—	26	—		
				2.0	125	—	—	156	—	ns	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	—				
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	$C_{in}$	—	—	5	10	—	10	pF			

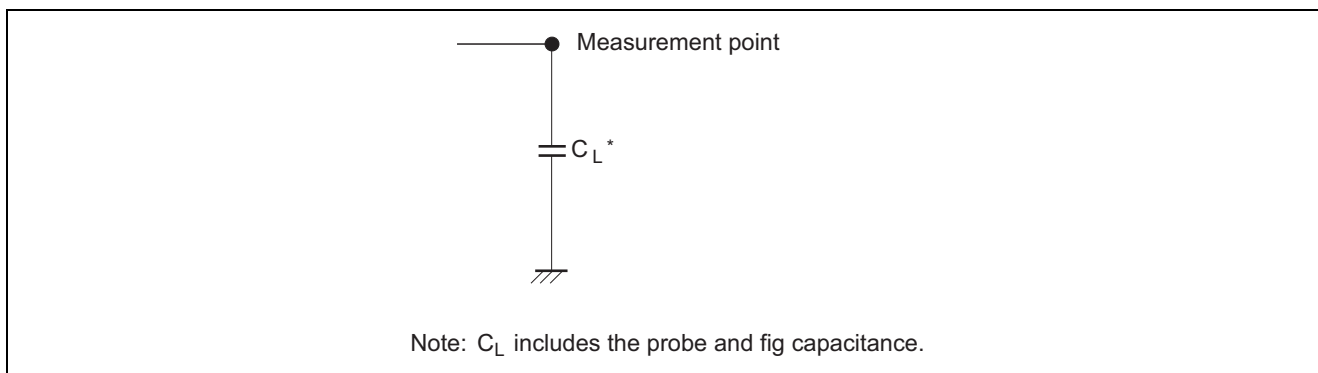
## Function Table

### Count Enable/Disable

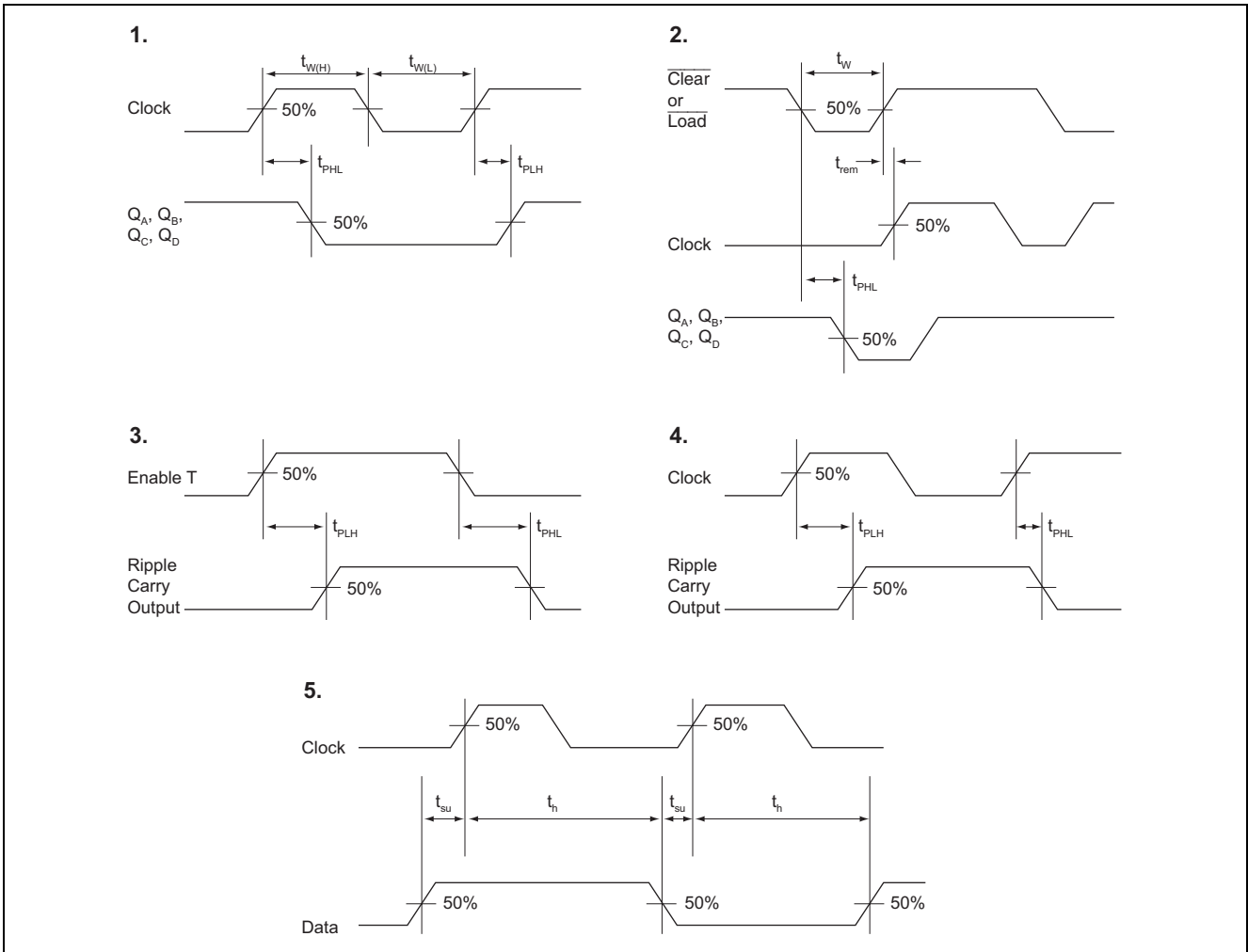
Control Inputs			Result at Outputs	
Load	Enable P	Enable T	Q <sub>A</sub> to Q <sub>D</sub>	Ripple Carry Output
H	H	H	Count	High when Q <sub>A</sub> to Q <sub>D</sub> are maximum
L	H	H	No count	
X	L	H	No count	High when Q <sub>A</sub> to Q <sub>D</sub> are maximum
X	H	L	No count	L
X	L	L	No count	L

H : High level    L : Low level    X : Irrelevant

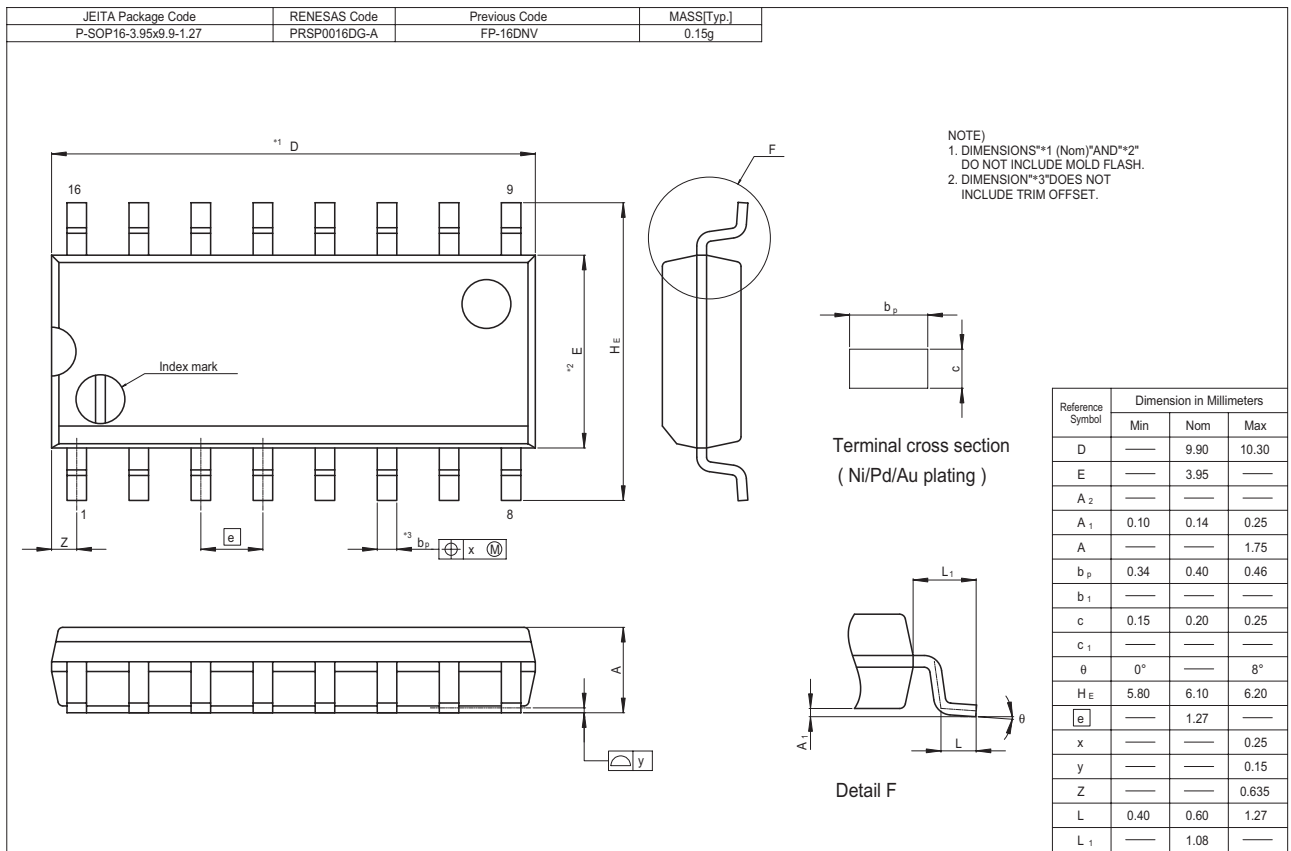
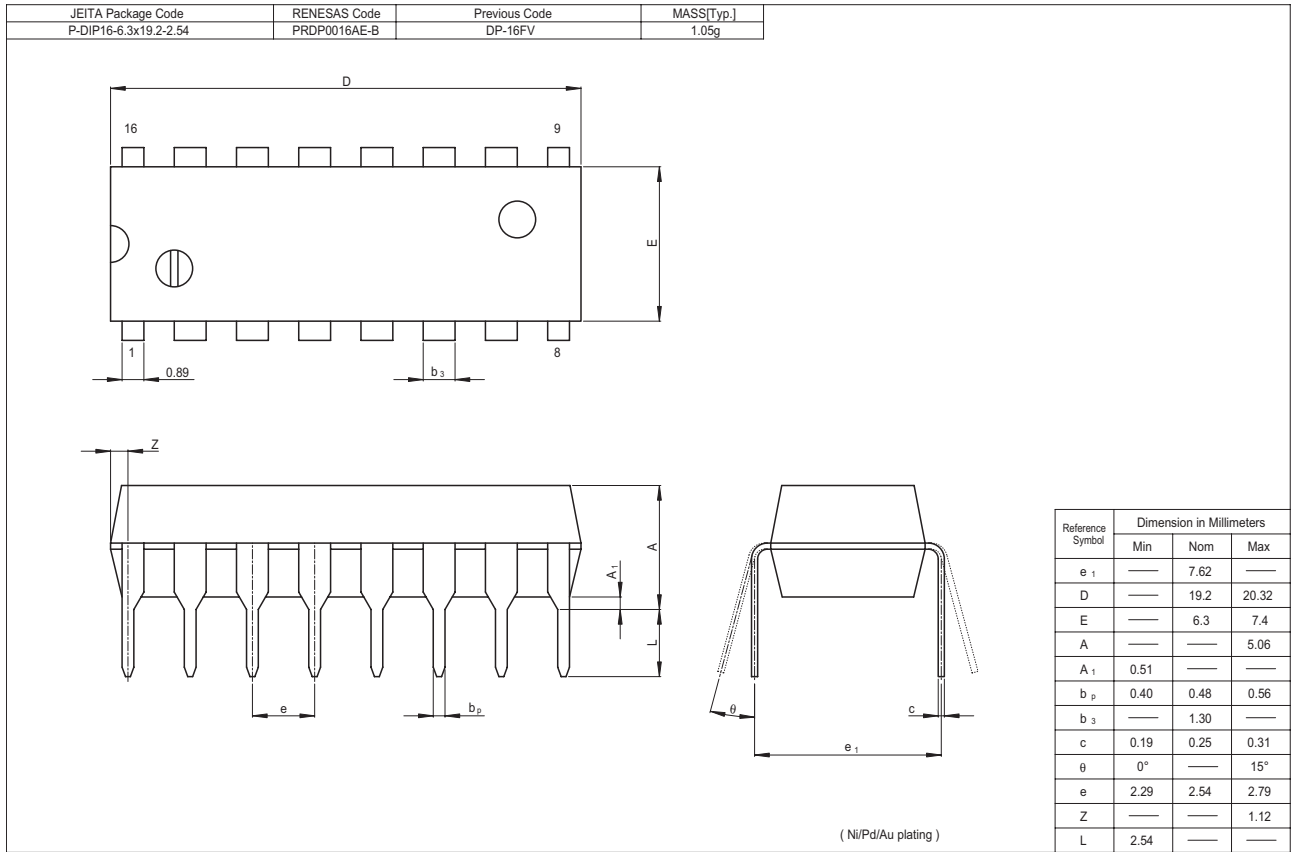
### Test Circuit



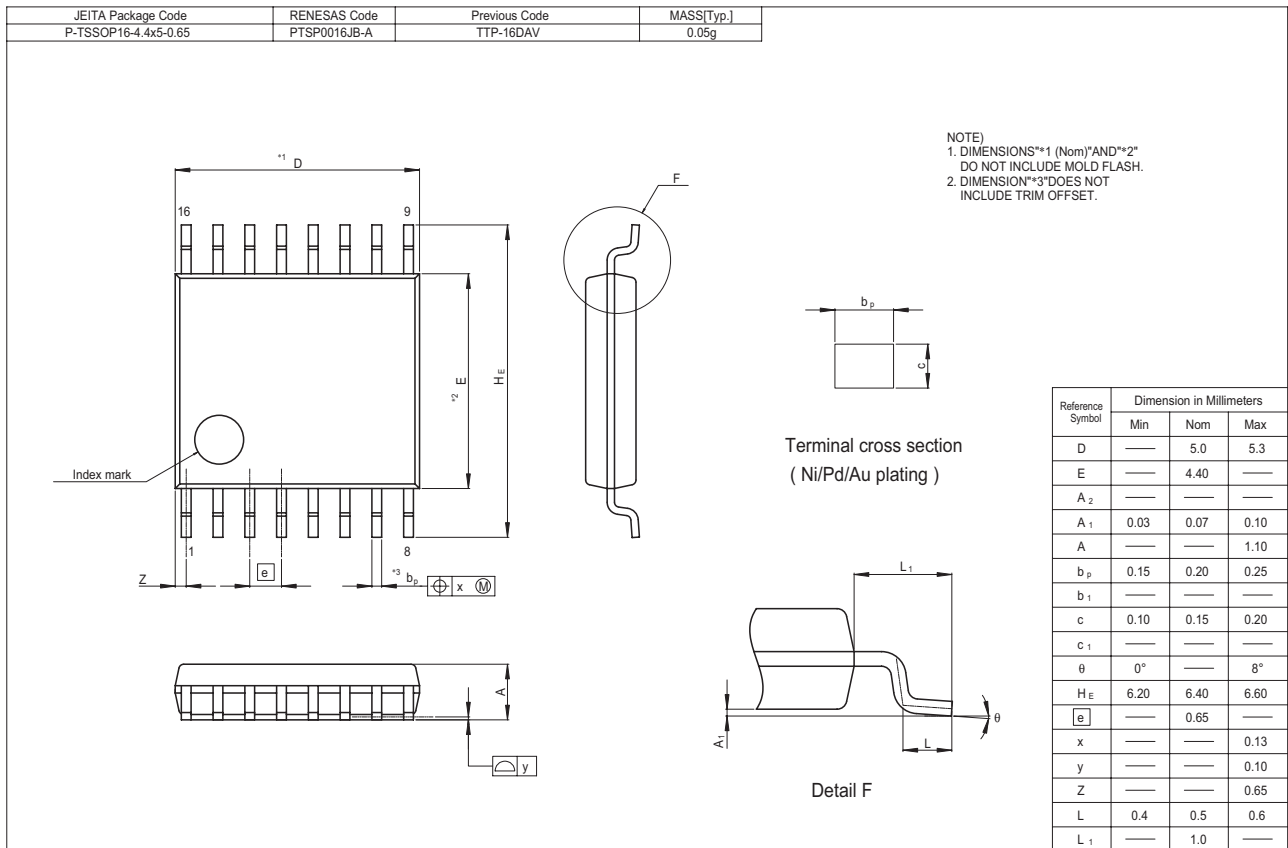
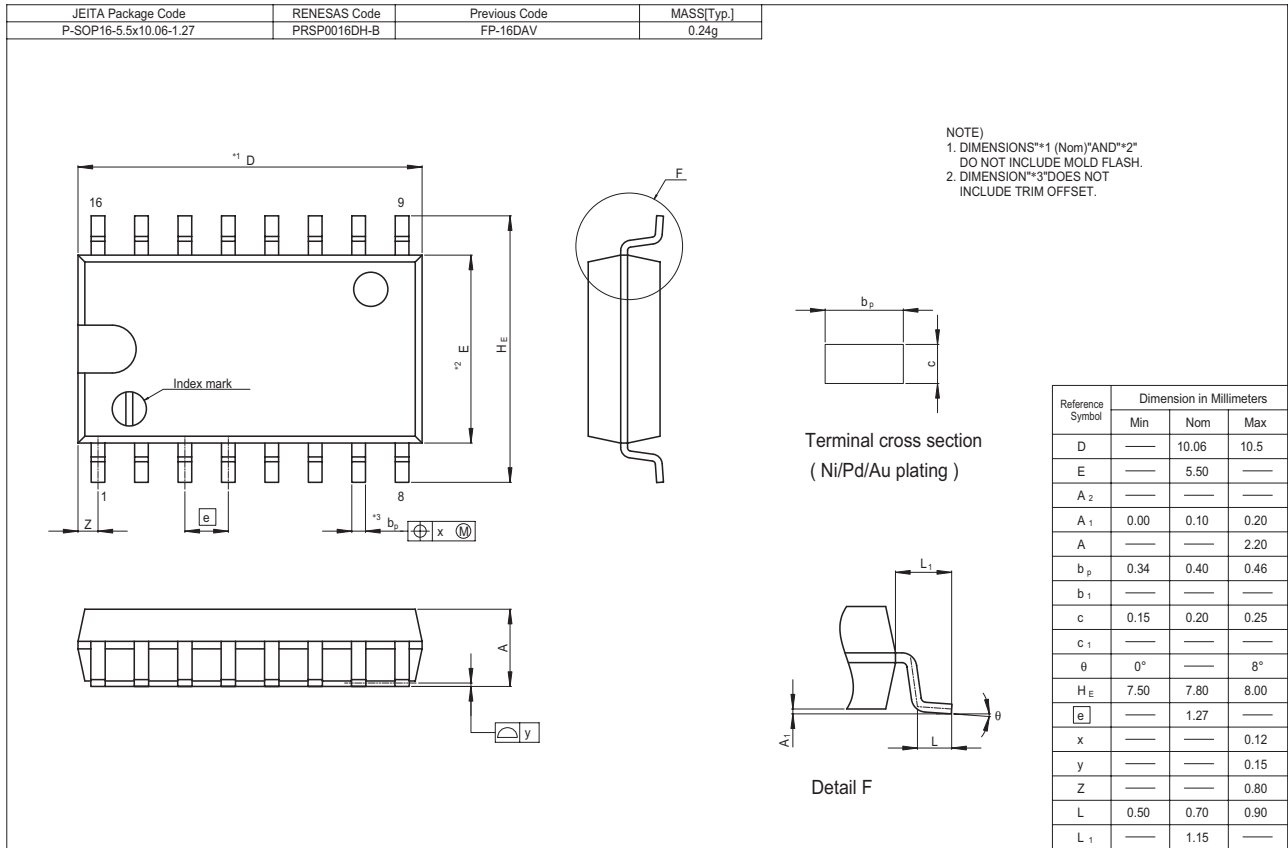
Waveforms



Package Dimensions



# HD74HC160, HD74HC161, HD74HC162, HD74HC163





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