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# HD74LV161A

Synchronous 4-bit Binary Counter (Direct Clear)

## HITACHI

ADE-205-264A (Z)  
2nd Edition  
June 1999

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### Description

The HD74LV161A is 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 clock. If the load input is taken high before the positive edge of clock the count operation will be unaffected. Low-voltage and high-speed operation is suitable for the battery-powered products (e.g., notebook computers), and the low-power consumption extends the battery life.

### Features

- $V_{CC} = 2.0\text{ V}$  to  $5.5\text{ V}$  operation
- All inputs  $V_{IH}(\text{Max.}) = 5.5\text{ V}$  ( $@V_{CC} = 0\text{ V}$  to  $5.5\text{ V}$ )
- All outputs  $V_O(\text{Max.}) = 5.5\text{ V}$  ( $@V_{CC} = 0\text{ V}$ )
- Typical  $V_{OL}$  ground bounce  $< 0.8\text{ V}$  ( $@V_{CC} = 3.3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )
- Typical  $V_{OH}$  undershoot  $> 2.3\text{ V}$  ( $@V_{CC} = 3.3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )
- Output current  $\pm 6\text{ mA}$  ( $@V_{CC} = 3.0\text{ V}$  to  $3.6\text{ V}$ ),  $\pm 12\text{ mA}$  ( $@V_{CC} = 4.5\text{ V}$  to  $5.5\text{ V}$ )

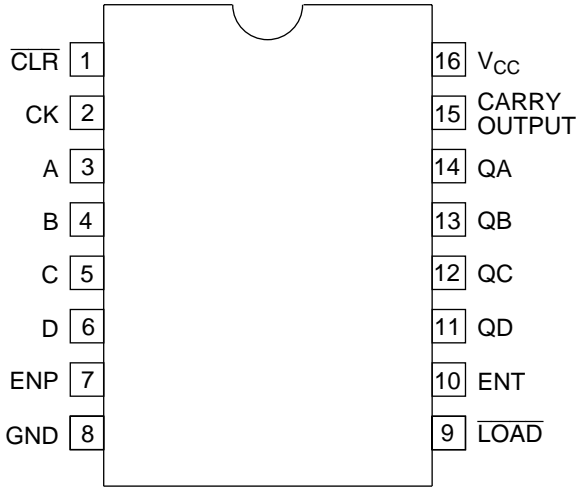
# HD74LV161A

## Function Table

Inputs					Outputs			
CLR	$\overline{\text{LOAD}}$	ENP	ENT	CLK	QA	QB	QC	QD
L	X	X	X	X	L	L	L	L
H	L	X	X	↑	A	B	C	D
H	H	X	L	↑	No change			
H	H	L	X	↑	No change			
H	H	H	H	↑	Count up			
H	X	X	X	↓	No change			

Note: H: High level  
L: Low level  
X: Immaterial  
↑: Low to high transition  
↓: High to low transition  
A, B, C, D: Data input  
Carry = ENT • QA • QB • QC • QD

## Pin Arrangement



(Top view)

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**Absolute Maximum Ratings**

Item	Symbol	Ratings	Unit	Conditions
Supply voltage range	$V_{CC}$	-0.5 to 7.0	V	
Input voltage range* <sup>1</sup>	$V_I$	-0.5 to 7.0	V	H or L
Output voltage range* <sup>1,2</sup>	$V_O$	-0.5 to $V_{CC} + 0.5$ -0.5 to 7.0	V	Output: H or L $V_{CC}$ : OFF
Input clamp current	$I_{IK}$	-20	mA	$V_I < 0$
Output clamp current	$I_{OK}$	$\pm 50$	mA	$V_O < 0$ or $V_O > V_{CC}$
Continuous output current	$I_O$	$\pm 25$	mA	$V_O = 0$ to $V_{CC}$
Continuous current through $V_{CC}$ or GND	$I_{CC}$ or $I_{GND}$	$\pm 50$	mA	
Maximum power dissipation at $T_a = 25^\circ\text{C}$ (in still air)* <sup>3</sup>	$P_T$	785	mW	SOP
		500		TSSOP
Storage temperature	$T_{stg}$	-65 to 150	$^\circ\text{C}$	

Notes: 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.

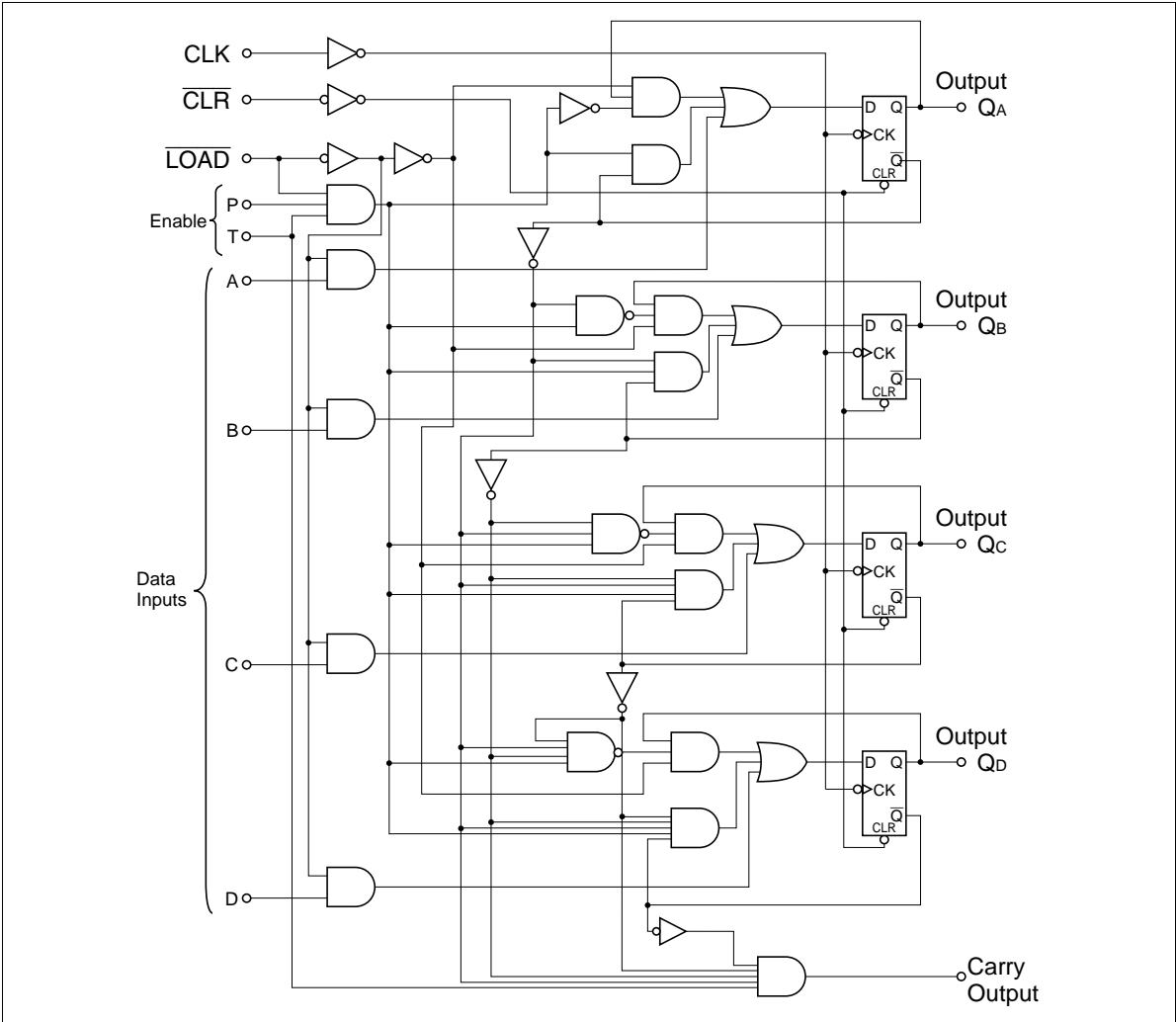
1. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. This value is limited to 5.5 V maximum.
3. The maximum package power dissipation was calculated using a junction temperature of  $150^\circ\text{C}$ .

**Recommended Operating Conditions**

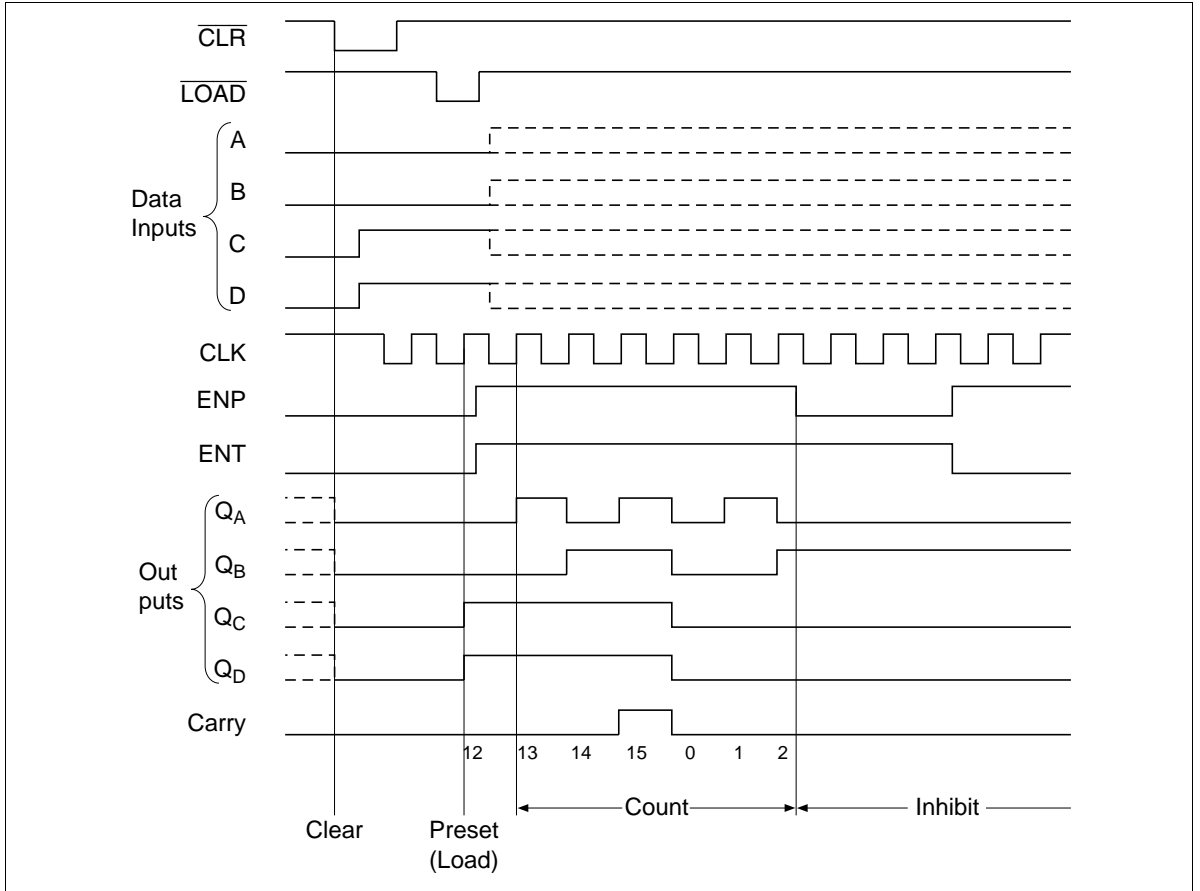
Item	Symbol	Min	Max	Unit	Conditions
Supply voltage range	$V_{CC}$	2.0	5.5	V	
Input voltage range	$V_I$	0	5.5	V	
Output voltage range	$V_O$	0	$V_{CC}$	V	
Output current	$I_{OH}$	—	-50	$\mu A$	$V_{CC} = 2.0 V$
		—	-2	$mA$	$V_{CC} = 2.3 \text{ to } 2.7 V$
		—	-6		$V_{CC} = 3.0 \text{ to } 3.6 V$
		—	-12		$V_{CC} = 4.5 \text{ to } 5.5 V$
	$I_{OL}$	—	50	$\mu A$	$V_{CC} = 2.0 V$
		—	2	$mA$	$V_{CC} = 2.3 \text{ to } 2.7 V$
		—	6		$V_{CC} = 3.0 \text{ to } 3.6 V$
		—	12		$V_{CC} = 4.5 \text{ to } 5.5 V$
Input transition rise or fall rate	$\Delta t / \Delta v$	0	200	$ns/V$	$V_{CC} = 2.3 \text{ to } 2.7 V$
		0	100		$V_{CC} = 3.0 \text{ to } 3.6 V$
		0	20		$V_{CC} = 4.5 \text{ to } 5.5 V$
Operating free-air temperature	$T_a$	-40	85	$^{\circ}C$	

Note: Unused or floating inputs must be held high or low.

Logic Diagram



## Timing Diagram



**DC Electrical Characteristics**

- $T_a = -40$  to  $85^\circ\text{C}$

Item	Symbol	$V_{CC}$ (V)*	Min	Typ	Max	Unit	Test Conditions
Input voltage	$V_{IH}$	2.0	1.5	—	—	V	
		2.3 to 2.7	$V_{CC} \times 0.7$	—	—		
		3.0 to 3.6	$V_{CC} \times 0.7$	—	—		
		4.5 to 5.5	$V_{CC} \times 0.7$	—	—		
	$V_{IL}$	2.0	—	—	0.5		
		2.3 to 2.7	—	—	$V_{CC} \times 0.3$		
		3.0 to 3.6	—	—	$V_{CC} \times 0.3$		
		4.5 to 5.5	—	—	$V_{CC} \times 0.3$		
Output voltage	$V_{OH}$	Min to Max	$V_{CC} - 0.1$	—	—	V	$I_{OL} = -50 \mu\text{A}$
		2.3	2.0	—	—		$I_{OL} = -2 \text{ mA}$
		3.0	2.48	—	—		$I_{OL} = -6 \text{ mA}$
		4.5	3.8	—	—		$I_{OL} = -12 \text{ mA}$
	$V_{OL}$	Min to Max	—	—	0.1		$I_{OL} = 50 \mu\text{A}$
		2.3	—	—	0.4		$I_{OL} = 2 \text{ mA}$
		3.0	—	—	0.44		$I_{OL} = 6 \text{ mA}$
		4.5	—	—	0.55		$I_{OL} = 12 \text{ mA}$
Input current	$I_{IN}$	0 to 5.5	—	—	$\pm 1$	$\mu\text{A}$	$V_{IN} = 5.5 \text{ V}$ or GND
Quiescent supply current	$I_{CC}$	5.5	—	—	20	$\mu\text{A}$	$V_{IN} = V_{CC}$ or GND, $I_O = 0$
Output leakage current	$I_{OFF}$	0	—	—	5	$\mu\text{A}$	$V_O = 5.5 \text{ V}$
Input capacitance	$C_{IN}$	3.3	—	1.7	—	pF	$V_I = V_{CC}$ or GND

Note: For conditions shown as Min or Max, use the appropriate values under recommended operating conditions.

## Switching Characteristics

- $V_{CC} = 2.5 \pm 0.2 \text{ V}$

Item	Symbol	Ta = 25°C			Ta = -40 to 85°C		Unit	Test Conditions	FROM (Input)	TO (Output)
		Min	Typ	Max	Min	Max				
Maximum clock frequency	fmax	50	90	—	40	—	MHz	C <sub>L</sub> = 15 pF		
		30	60	—	25	—				
Propagation delay time	t <sub>PLH</sub> /t <sub>PHL</sub>	—	11.1	16.2	1.0	19.5	ns	C <sub>L</sub> = 15 pF	CLK	Q
		—	14.3	19.2	1.0	22.5				
	t <sub>PLH</sub> /t <sub>PHL</sub>	—	11.5	17.0	1.0	20.5		C <sub>L</sub> = 15 pF	CLK	Carry
	Count mode	—	14.7	20.0	1.0	23.5		C <sub>L</sub> = 50 pF		
	t <sub>PLH</sub> /t <sub>PHL</sub>	—	13.8	20.6	1.0	24.5		C <sub>L</sub> = 15 pF	CLK	Carry
	Load mode	—	17.0	23.6	1.0	27.5		C <sub>L</sub> = 50 pF		
	t <sub>PLH</sub> /t <sub>PHL</sub>	—	10.3	15.7	1.0	19.0		C <sub>L</sub> = 15 pF	ENT	Carry
		—	14.0	18.7	1.0	22.0		C <sub>L</sub> = 50 pF		
	t <sub>PHL</sub>	—	11.7	17.0	1.0	20.5		C <sub>L</sub> = 15 pF	CLR	Q
		—	14.7	20.0	1.0	23.5		C <sub>L</sub> = 50 pF		
t <sub>PHL</sub>	—	11.2	16.6	1.0	20.0		C <sub>L</sub> = 15 pF	CLR	Carry	
	—	14.4	19.6	1.0	23.0		C <sub>L</sub> = 50 pF			
Setup time	t <sub>su</sub>	7.5	—	—	8.5	—	ns		Data before CLK ↑	
		10.0	—	—	11.5	—			LOAD before CLK ↑	
		9.5	—	—	11.0	—			ENT, ENP before CLK ↑	
		4.5	—	—	4.5	—			CLR inactive before CLK ↑	
Hold time	t <sub>h</sub>	1.5	—	—	1.5	—				
Pulse width	t <sub>w</sub>	7.0	—	—	7.0	—			CLK H or L	
		7.0	—	—	7.0	—			CLR L	



**Switching Characteristics (cont)**

- $V_{CC} = 3.3 \pm 0.3 \text{ V}$

Item	Symbol	Ta = 25°C			Ta = -40 to 85°C		Unit	Test Conditions	FROM (Input)	TO (Output)
		Min	Typ	Max	Min	Max				
Maximum clock frequency	fmax	80	130	—	70	—	MHz	C <sub>L</sub> = 15 pF		
		55	85	—	50	—				
Propagation delay time	t <sub>PLH</sub> /t <sub>PHL</sub>	—	8.3	12.8	1.0	15.0	ns	C <sub>L</sub> = 15 pF	CLK	Q
		—	10.8	16.3	1.0	18.5				
	t <sub>PLH</sub> /t <sub>PHL</sub>	—	8.7	13.6	1.0	16.0	ns	C <sub>L</sub> = 15 pF	CLK	Carry
	Count mode	—	11.2	17.1	1.0	19.5		C <sub>L</sub> = 50 pF		
	t <sub>PLH</sub> /t <sub>PHL</sub>	—	11.0	17.2	1.0	20.0	ns	C <sub>L</sub> = 15 pF	CLK	Carry
	Load mode	—	13.5	20.7	1.0	23.5		C <sub>L</sub> = 50 pF		
	t <sub>PLH</sub> /t <sub>PHL</sub>	—	7.5	12.3	1.0	14.5	ns	C <sub>L</sub> = 15 pF	ENT	Carry
		—	10.5	15.8	1.0	18.0		C <sub>L</sub> = 50 pF		
	t <sub>PHL</sub>	—	8.9	13.6	1.0	16.0	ns	C <sub>L</sub> = 15 pF	CLR	Q
		—	11.2	17.1	1.0	19.5		C <sub>L</sub> = 50 pF		
t <sub>PHL</sub>	—	8.4	13.2	1.0	15.5	ns	C <sub>L</sub> = 15 pF	CLR	Carry	
	—	10.9	16.7	1.0	19.0		C <sub>L</sub> = 50 pF			
Setup time	t <sub>su</sub>	5.5	—	—	6.5	—	ns			Data before CLK ↑
		8.0	—	—	9.5	—				LOAD before CLK ↑
		7.5	—	—	9.0	—				ENT, ENP before CLK ↑
		2.5	—	—	2.5	—				CLR inactive before CLK ↑
Hold time	t <sub>h</sub>	1.0	—	—	1.0	—	ns			
Pulse width	t <sub>w</sub>	5.0	—	—	5.0	—	ns			CLK H or L
		5.0	—	—	5.0	—				CLR L

## Switching Characteristics (cont)

- $V_{CC} = 5.0 \pm 0.5 \text{ V}$

Item	Symbol	Ta = 25°C			Ta = -40 to 85°C		Unit	Test Conditions	FROM (Input)	TO (Output)
		Min	Typ	Max	Min	Max				
Maximum clock frequency	fmax	135	185	—	115	—	MHz	C <sub>L</sub> = 15 pF		
		95	125	—	85	—				
Propagation delay time	t <sub>PLH</sub> /t <sub>PHL</sub>	—	4.9	8.1	1.0	9.5	ns	C <sub>L</sub> = 15 pF	CLK	Q
		—	8.7	10.1	1.0	11.5				
	t <sub>PLH</sub> /t <sub>PHL</sub>	—	4.9	8.1	1.0	9.5		C <sub>L</sub> = 15 pF	CLK	Carry
	Count mode	—	6.4	10.1	1.0	20.0		C <sub>L</sub> = 50 pF		
	t <sub>PLH</sub> /t <sub>PHL</sub>	—	6.2	10.3	1.0	12.0		C <sub>L</sub> = 15 pF	CLK	Carry
	Load mode	—	7.7	12.3	1.0	14.0		C <sub>L</sub> = 50 pF		
	t <sub>PLH</sub> /t <sub>PHL</sub>	—	4.9	8.1	1.0	9.5		C <sub>L</sub> = 15 pF	ENT	Carry
		—	6.4	10.1	1.0	11.5		C <sub>L</sub> = 50 pF		
	t <sub>PHL</sub>	—	5.5	9.0	1.0	10.5		C <sub>L</sub> = 15 pF	CLR	Q
		—	7.0	11.0	1.0	12.5		C <sub>L</sub> = 50 pF		
t <sub>PHL</sub>	—	5.0	8.6	1.0	10.0		C <sub>L</sub> = 15 pF	CLR	Carry	
	—	6.5	10.6	1.0	12.0		C <sub>L</sub> = 50 pF			
Setup time	t <sub>su</sub>	4.5	—	—	4.5	—	ns			Data before CLK ↑
		5.0	—	—	6.0	—				LOAD before CLK ↑
		5.0	—	—	6.0	—				ENT, ENP before CLK ↑
		1.5	—	—	1.5	—				CLR inactive before CLK ↑
Hold time	t <sub>h</sub>	1.0	—	—	1.0	—				
Pulse width	t <sub>w</sub>	5.0	—	—	5.0	—			CLK H or L	
		5.0	—	—	5.0	—			CLR L	

## Operating Characteristics

- $C_L = 50 \text{ pF}$

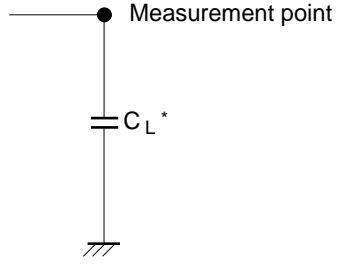
Item	Symbol	$V_{CC}$ (V)	$T_a = 25^\circ\text{C}$			Unit	Test Conditions
			Min	Typ	Max		
Power dissipation capacitance	$C_{PD}$	3.3	—	17.0	—	pF	f = 10 MHz
		5.0	—	20.4	—		

## Noise Characteristics

- $C_L = 50 \text{ pF}$

Item	Symbol	$V_{CC}$ (V)	$T_a = 25^\circ\text{C}$			Unit	Test Conditions
			Min	Typ	Max		
Quiet output, maximum dynamic $V_{OL}$	$V_{OL(P)}$	3.3	—	0.3	0.8	V	
Quiet output, minimum dynamic $V_{OL}$	$V_{OL(V)}$	3.3	—	-0.3	-0.8		
Quiet output, minimum dynamic $V_{OH}$	$V_{OH(V)}$	3.3	—	3.0	—		
High-level dynamic input voltage	$V_{IH(D)}$	3.3	2.31	—	—	V	
Low-level dynamic input voltage	$V_{IL(D)}$	3.3	—	—	0.99		

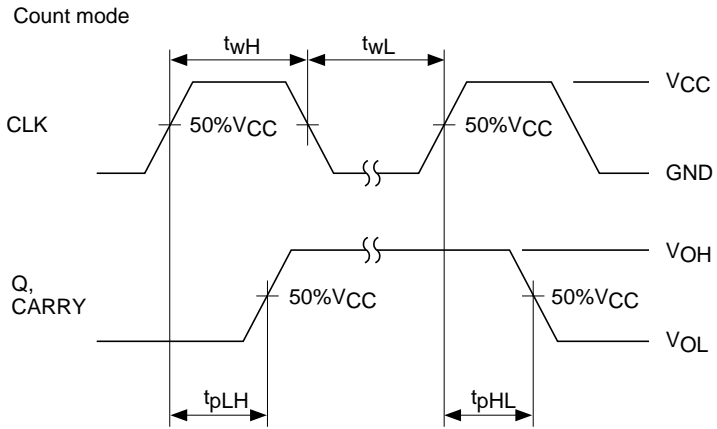
**Test Circuit**



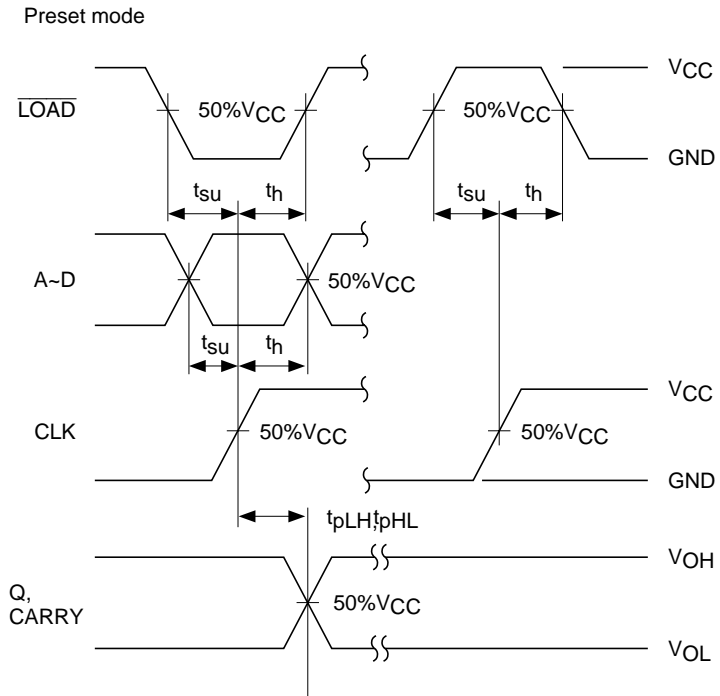
Note: 1.  $C_L$  includes the probe and jig capacitance.

Waveform

Waveform – 1

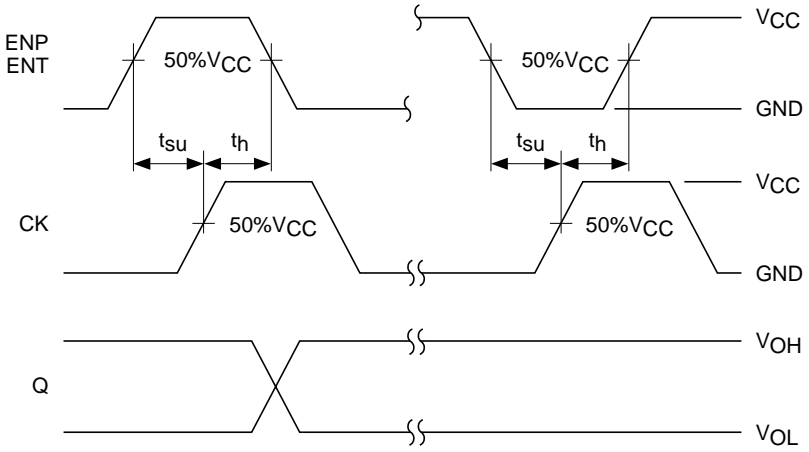


Waveform – 2



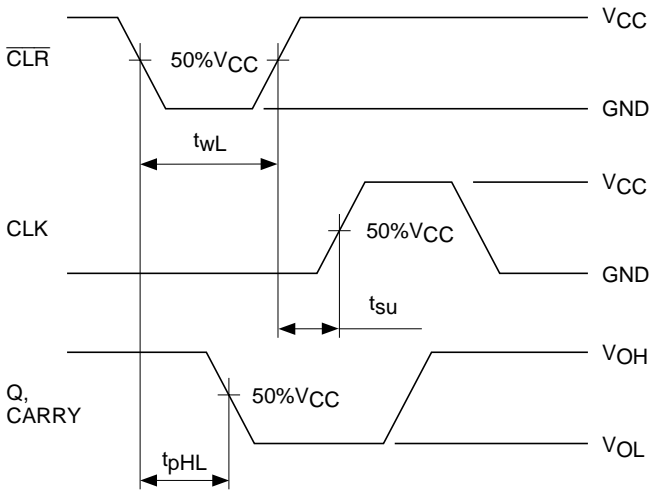
Waveform – 3

Count enable mode



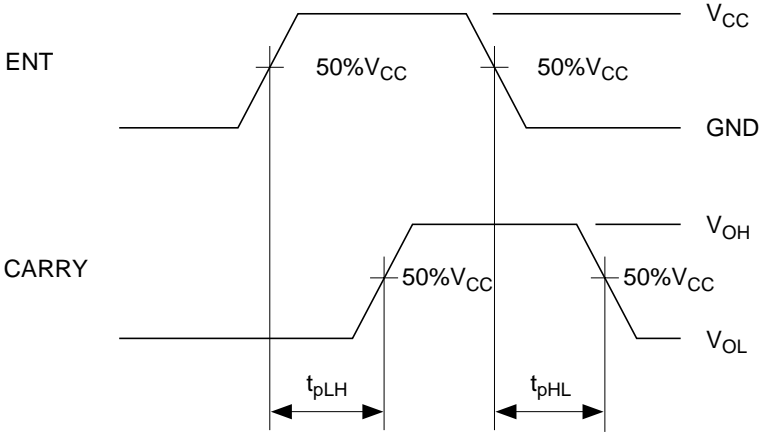
Waveform – 4

Clear mode



Waveform – 5

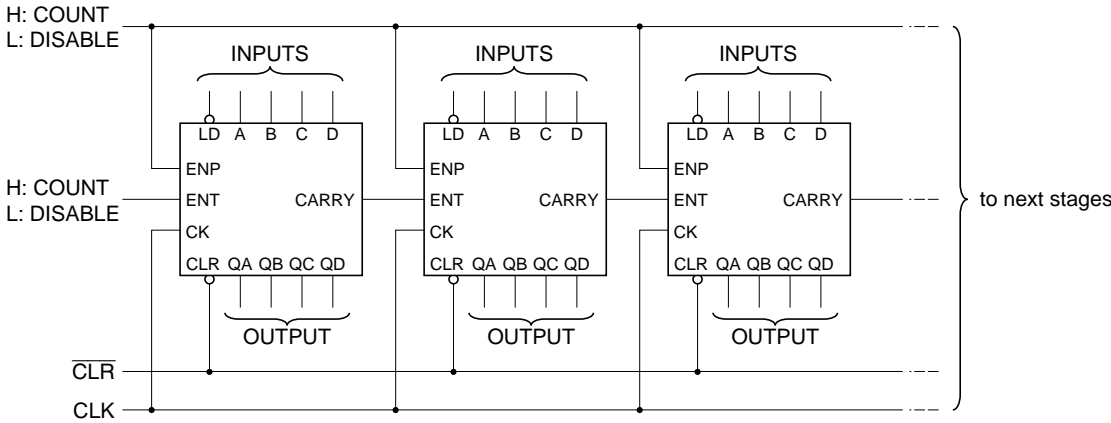
Cascade mode  
(Set to maximum count number)



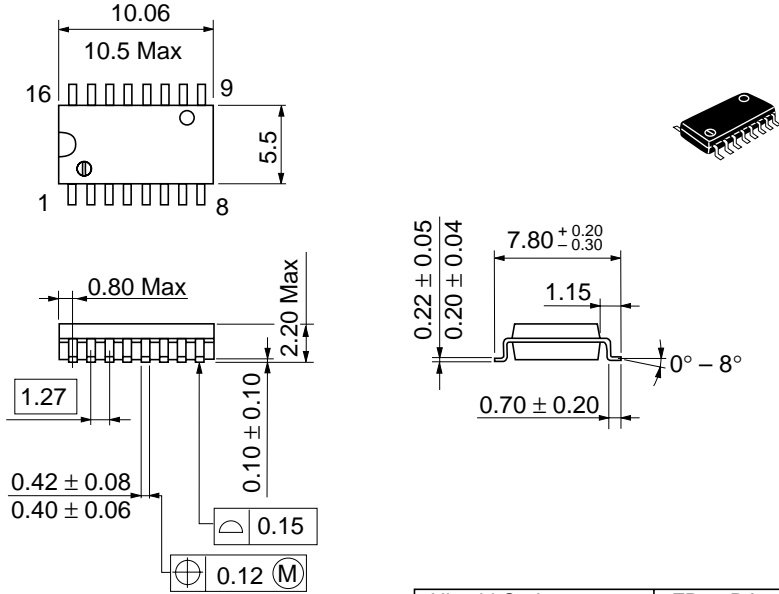
Note: 1. Input waveform: PRR ≤ 1 MHz, Z<sub>o</sub> = 50 Ω, t<sub>r</sub> ≤ 3 ns, t<sub>f</sub> ≤ 3 ns

Application

Cascade circuitry



## Package Dimensions

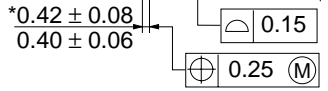
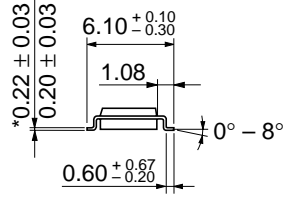
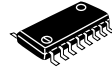
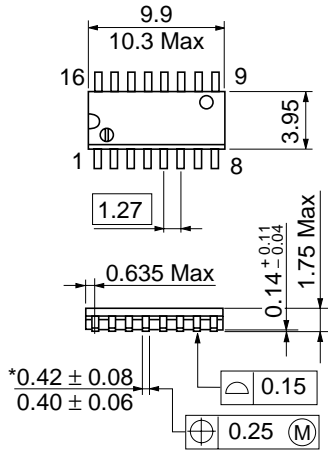


Dimension including the plating thickness  
Base material dimension

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



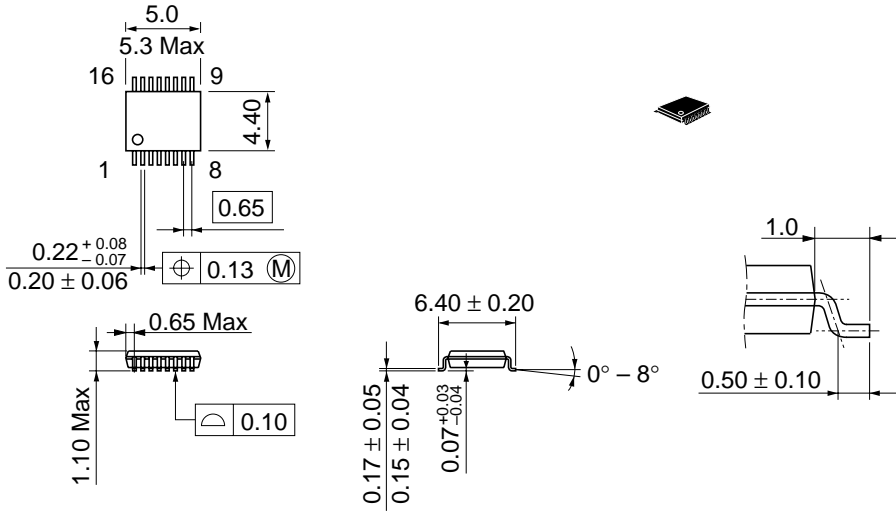
Unit: mm



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

\*Dimension including the plating thickness  
Base material dimension

# HD74LV161A



Dimension including the plating thickness  
Base material dimension

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

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## 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

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Singapore 049318  
Tel: 535-2100  
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Taipei Branch Office  
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Tel: <886> (2) 2718-3666  
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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

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