HD74LV161A

Synchronous 4-bit Binary Counter (Direct Clear)

HITACHI

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

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 tha 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 V to 5.5 V operation
- All inputs V_{IH} (Max.) = 5.5 V (@V_{CC} = 0 V to 5.5 V)
- All outputs V_O (Max.) = 5.5 V (@V_{CC} = 0 V)
- Typical V_{OL} ground bounce < 0.8 V (@V_{CC} = 3.3 V, Ta = 25°C)
- Typical V_{OH} undershoot > 2.3 V (@V_{CC} = 3.3 V, Ta = 25°C)
- Output current ±6 mA (@V_{CC} = 3.0 V to 3.6 V), ±12 mA (@V_{CC} = 4.5 V to 5.5 V)

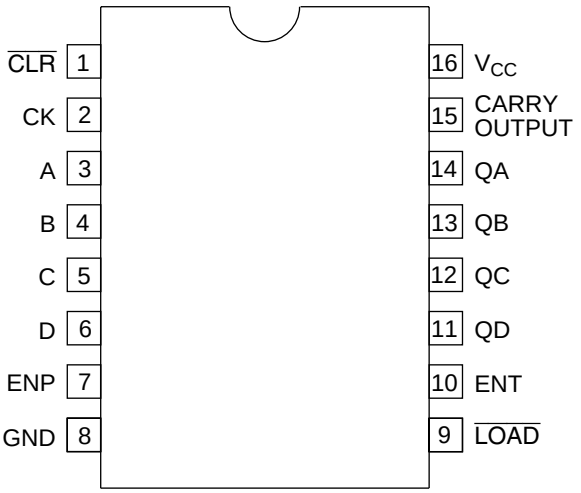
Hitachi semiconductor

Function Table

Inputs					Outputs			
$\overline{CLR}$	$\overline{LOAD}$	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)

Absolute Maximum Ratings

Item	Symbol	Ratings	Unit	Conditions
Supply voltage range	V_{CC}	–0.5 to 7.0	V	
Input voltage range*[1]	V_I	–0.5 to 7.0	V	H or L
Output voltage range*[1, 2]	V_O	–0.5 to V_{CC} + 0.5	V	Output: H or L
		–0.5 to 7.0		V_{CC}: OFF
Input clamp current	I_{IK}	–20	mA	$V_I < 0$
Output clamp current	I_{OK}	±50	mA	$V_O < 0$ or $V_O > V_{CC}$
Continuous output current	I_O	±25	mA	V_O = 0 to V_{CC}
Continuous current through V_{CC} or GND	I_{CC} or I_{GND}	±50	mA	
Maximum power dissipation at Ta = 25°C (in still air)*[3]	P_T	785	mW	SOP
		500		TSSOP
Storage temperature	Tstg	–65 to 150	°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.

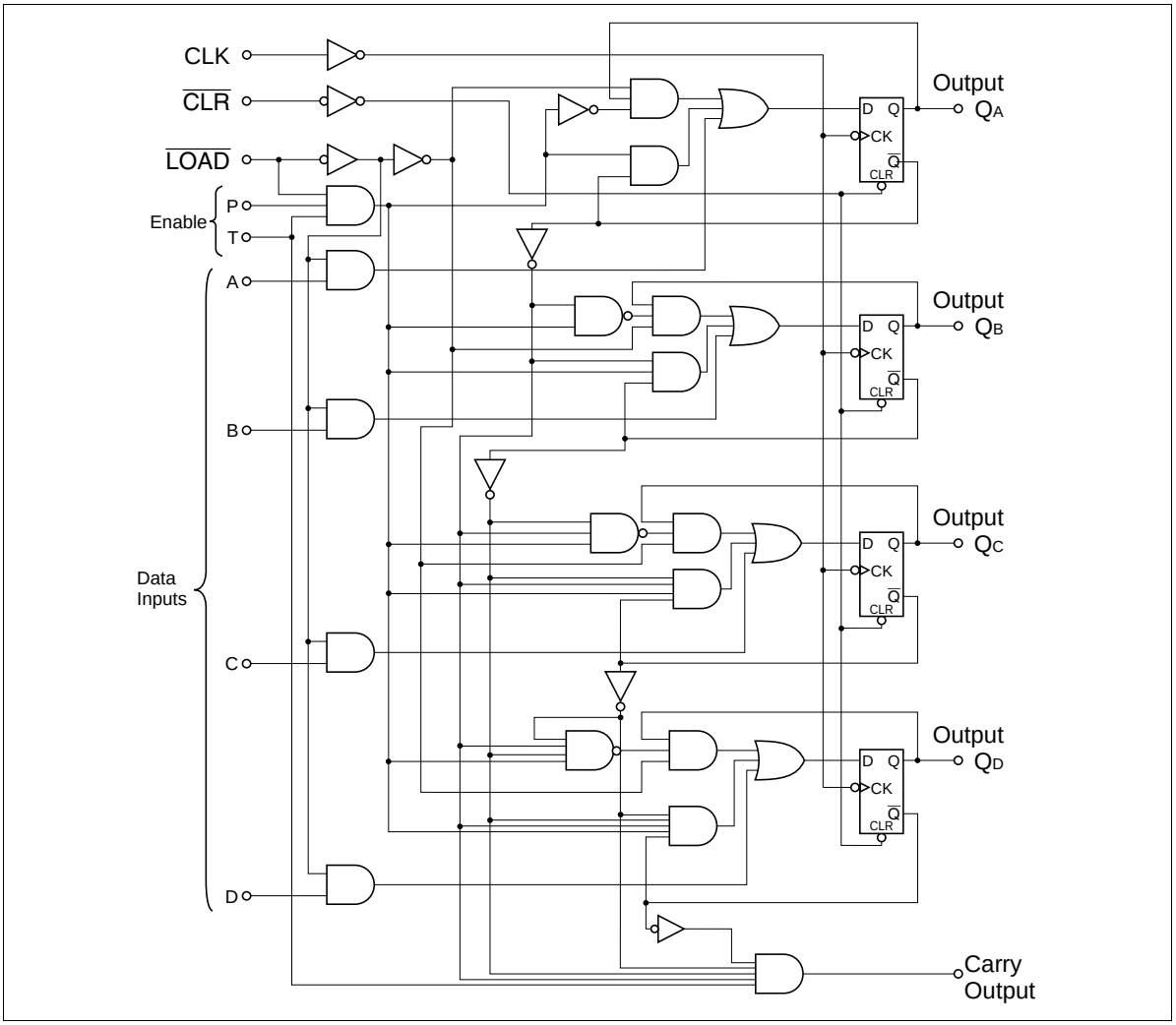
1. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. This value is limited to 5.5 V maximum.
3. The maximum package power dissipation was calculated using a junction temperature of 150°C.

Recommended Operating Conditions

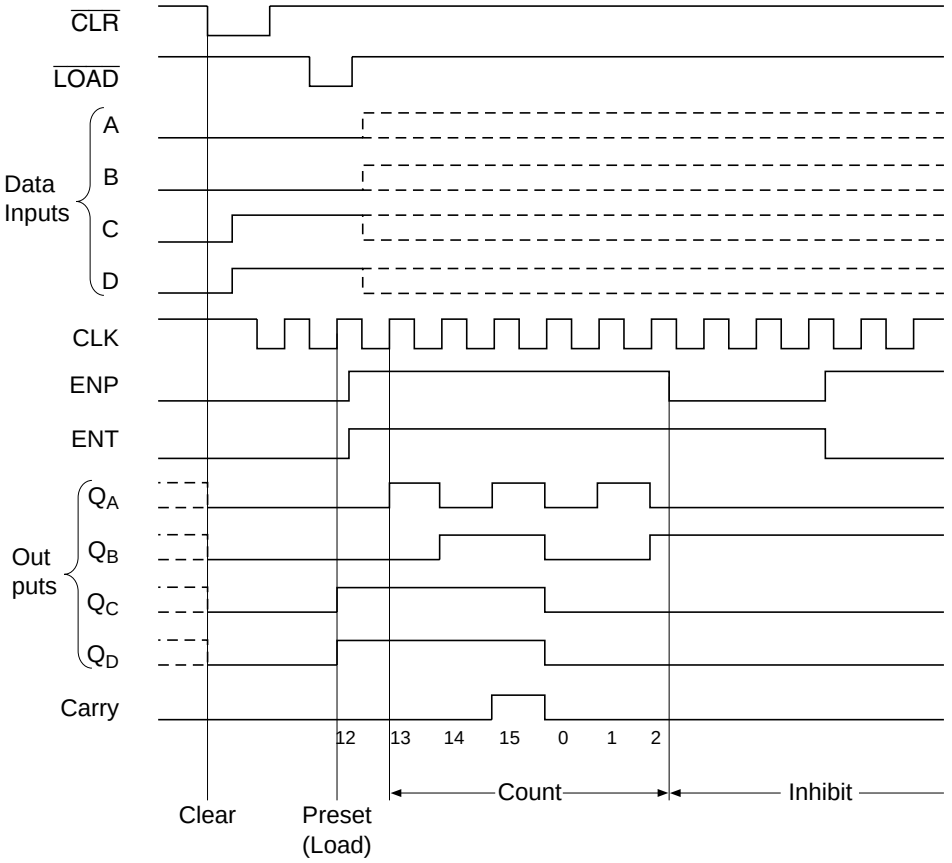
Item	Symbol	Min	Max	Unit	Conditions
Supply voltage range	V_{CC}	2.0	5.5	V	
Input voltage range	V_I	0	5.5	V	
Output voltage range	V_O	0	V_{CC}	V	
Output current	I_{OH}	—	–50	µA	V_{CC} = 2.0 V
		—	–2	mA	V_{CC} = 2.3 to 2.7 V
		—	–6		V_{CC} = 3.0 to 3.6 V
		—	–12		V_{CC} = 4.5 to 5.5 V
	I_{OL}	—	50	µA	V_{CC}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

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

Logic Diagram



Timing Diagram



DC Electrical Characteristics

- **Ta = –40 to 85°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 µA
		2.3	2.0	—	—		I_{OL} = –2 mA
		3.0	2.48	—	—		I_{OL} = –6 mA
		4.5	3.8	—	—		I_{OL} = –12 mA
	V_{OL}	Min to Max	—	—	0.1		I_{OL} = 50 µA
		2.3	—	—	0.4		I_{OL} = 2 mA
		3.0	—	—	0.44		I_{OL} = 6 mA
		4.5	—	—	0.55		I_{OL} = 12 mA
Input current	I_{IN}	0 to 5.5	—	—	±1	µA	V_{IN} = 5.5 V or GND
Quiescent supply current	I_{CC}	5.5	—	—	20	µA	V_{IN} = V_{CC} or GND, I_O = 0
Output leakage current	I_{OFF}	0	—	—	5	µA	V_O = 5.5 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 ± 0.2 V

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

Switching Characteristics (cont)

- V_{CC} = 3.3 ± 0.3 V

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

Switching Characteristics (cont)

- V_{CC} = 5.0 ± 0.5 V

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

Operating Characteristics

- **C_L = 50 pF**

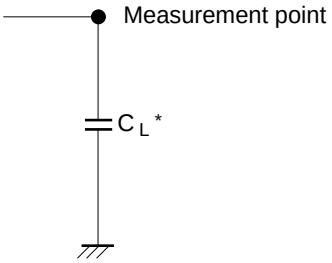
			Ta = 25°C				
Item	**Symbol**	**V_{cc} (V)**	**Min**	**Typ**	**Max**	**Unit**	**Test Conditions**
Power dissipation capacitance	C_{PD}	3.3	—	17.0	—	pF	f = 10 MHz
		5.0	—	20.4	—		

Noise Characteristics

- **C_L = 50 pF**

			Ta = 25°C				
Item	**Symbol**	**V_{cc} (V)**	**Min**	**Typ**	**Max**	**Unit**	**Test Conditions**
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

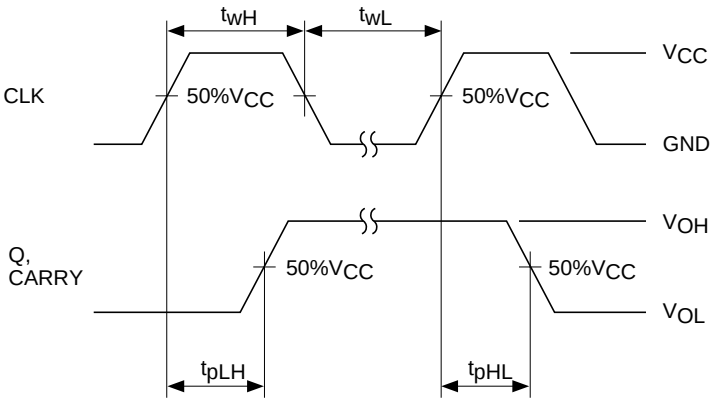


Note: 1. C_L includes the probe and jig capacitance.

Waveform

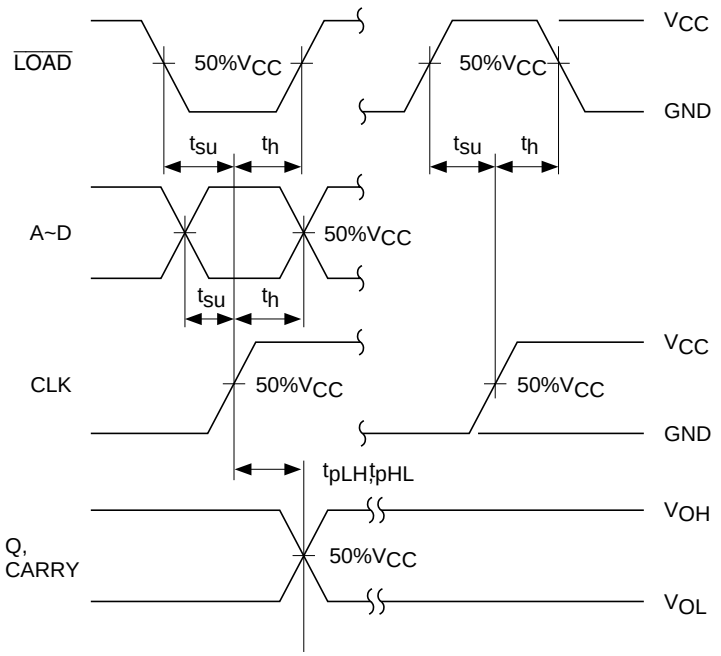
Waveform – 1

Count mode



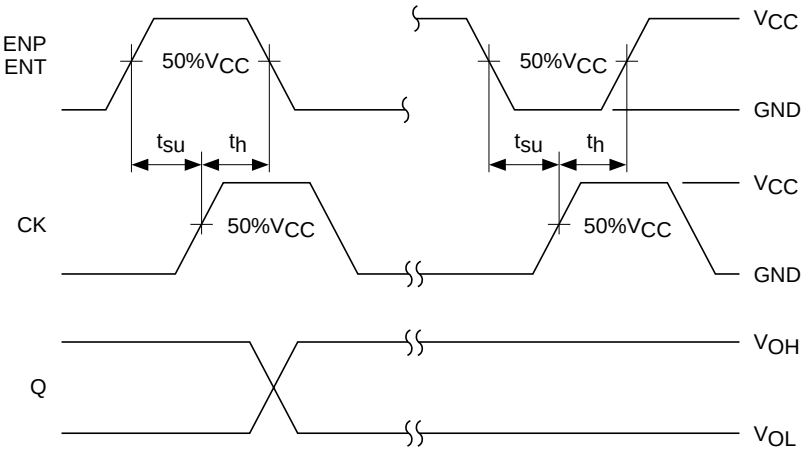
Waveform – 2

Preset mode



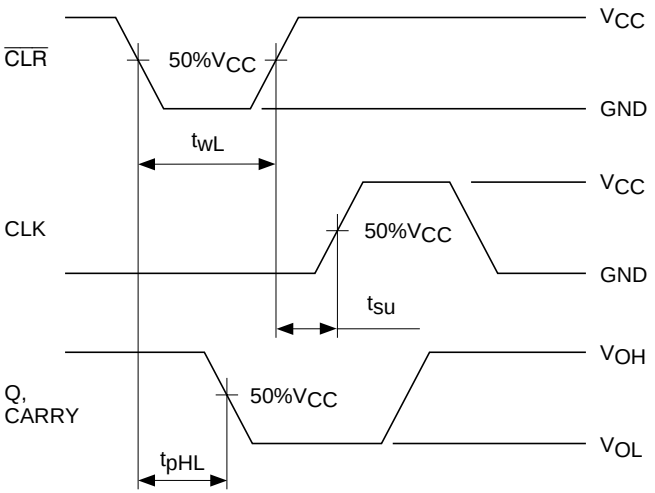
Waveform – 3

Count enable mode



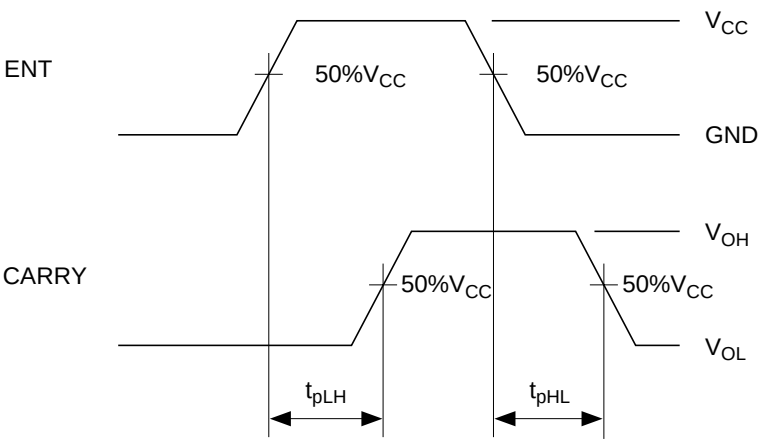
Waveform – 4

Clear mode



Waveform – 5

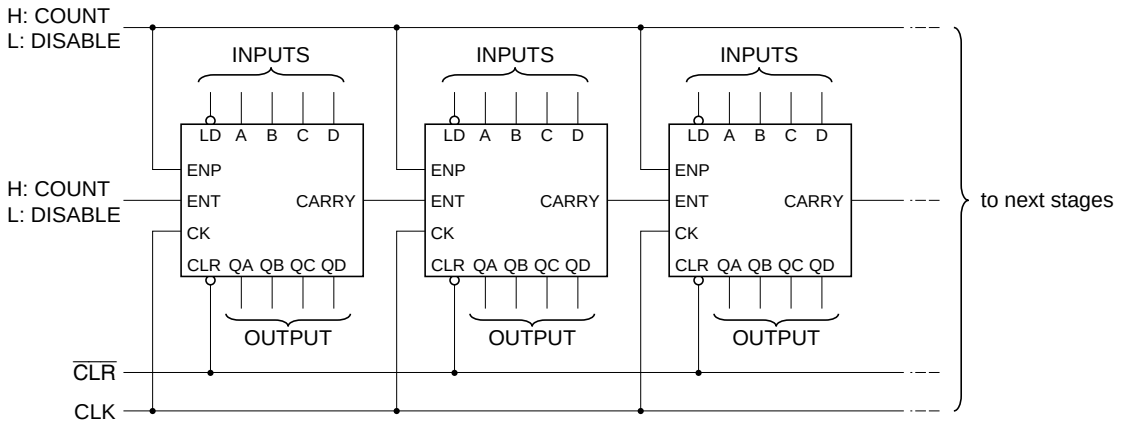
Cascade mode
(Set to maximum count number)



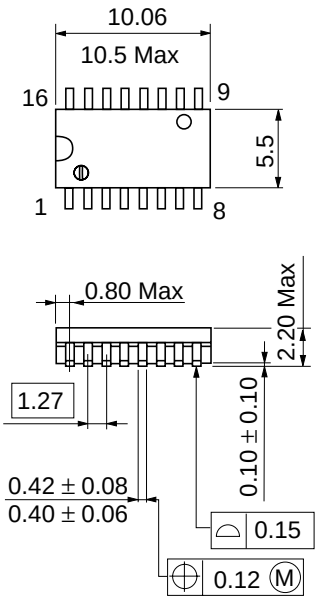
Note: 1. Input waveform: PRR ≤ 1 MHz, Zo = 50 Ω, t_r ≤ 3 ns, t_f ≤ 3 ns

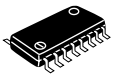
Application

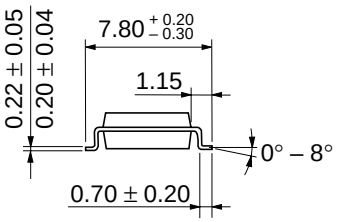
Cascade circuitry



Package Dimensions



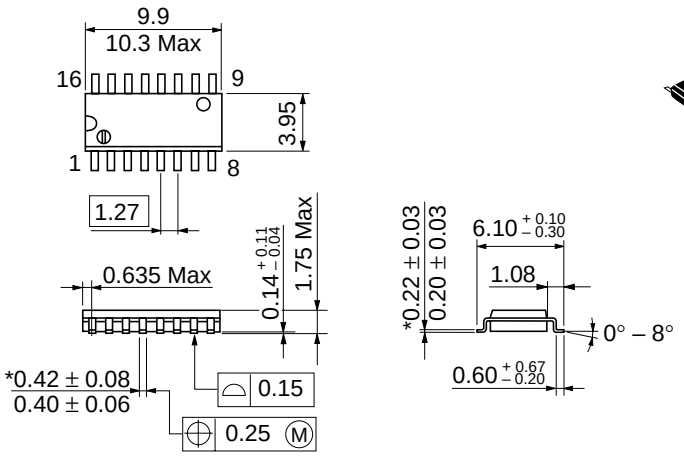




Dimension including the plating thickness
Base material dimension

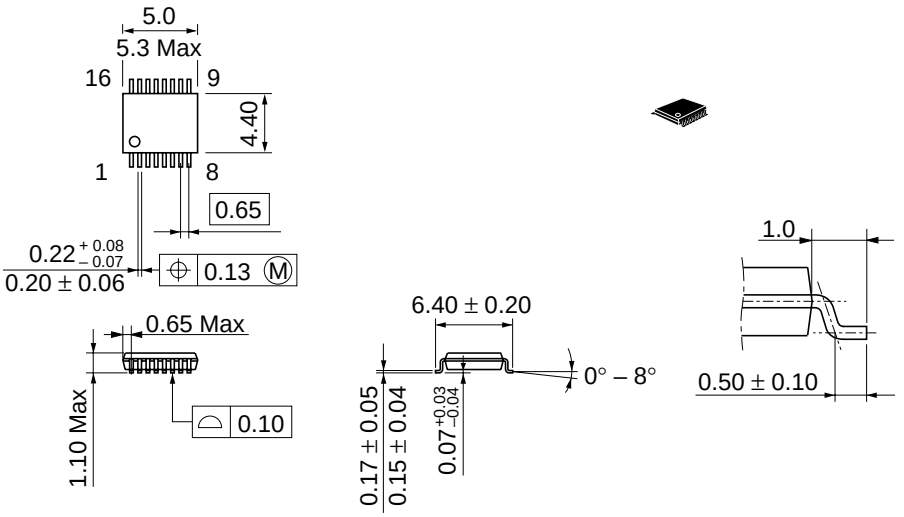
Hitachi Code	FP-16DA
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.24 g

Unit: mm



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

*Dimension including the plating thickness
Base material dimension



Dimension including the plating thickness
Base material dimension

Hitachi Code	TTP-16DA
JEDEC	—
EIAJ	—
Weight (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
NorthAmerica : http:semiconductor.hitachi.com/
Europe : http://www.hitachi-eu.com/hel/ecg
Asia (Singapore) : http://www.has.hitachi.com.sg/grp3/sicd/index.htm
Asia (Taiwan) : http://www.hitachi.com.tw/E/Product/SICD_Frame.htm
Asia (HongKong) : http://www.hitachi.com.hk/eng/bo/grp3/index.htm
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) 778322

Hitachi Asia Pte. Ltd.
16 Collyer Quay #20-00
Hitachi Tower
Singapore 049318
Tel: 535-2100
Fax: 535-1533

Hitachi Asia Ltd.
Taipei Branch Office
3F, Hung Kuo Building. No.167,
Tun-Hwa North Road, Taipei (105)
Tel: <886> (2) 2718-3666
Fax: <886> (2) 2718-8180

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
Telex: 40815 HITEC HX