HD74LV393A

Dual 4-bit Binary Counters

HITACHI

ADE-205-276 (Z)
1st Edition
April 1999

Description

The HD74LV393A contain two 4-bit ripple carry binary counters, which can be cascaded to create a single divide-by-256 counter.
The HD74LV393A is incremented on the high to low transition (negative edge) of the clock input, and each has an independent clear input. When clear is set high all four bits of each counter are set to a low level. This enables count trucation and allows the implementation of divide-by-N counter configurations. 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)

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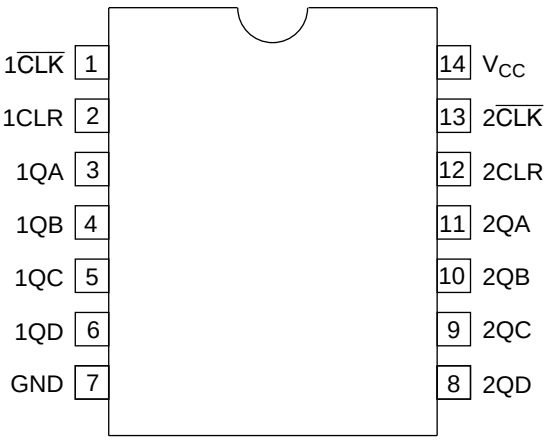
Function Table

Inputs		
$\overline{CLK}$	CLR	Output
X	H	L
H	L	No change
L	L	No change
↑	L	No change
↓	L	Count up

Note: H: High level
L: Low level
X: Immaterial
↑: Low to high transition
↓: High to low transition

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	
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}	±70	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.

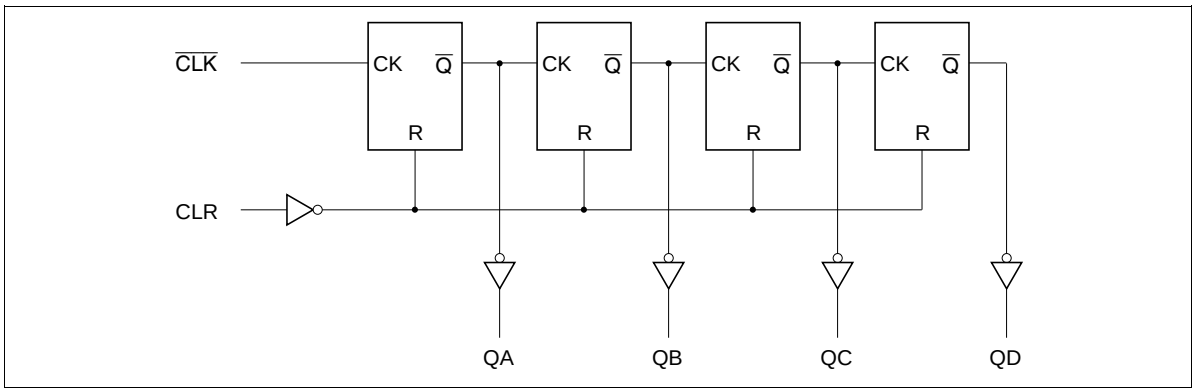
1. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. This value is limited to 5.5 V maximum.
3. The maximum package power dissipation was calculated using a junction temperature of 150°C.

Recommended Operating Conditions

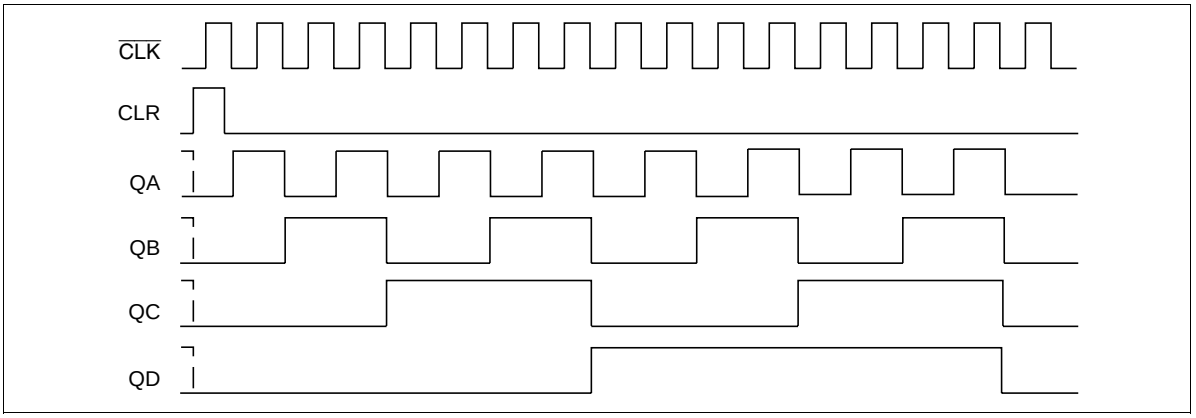
Item	Symbol	Min	Max	Unit	Conditions
Supply voltage range	V_{CC}	2.0	5.5	V	
Input voltage range	V_I	0	5.5	V	
Output voltage range	V_O	0	V_{CC}	V	H or L
Output current	I_{OH}	—	–50	µA	V_{CC} = 2.0 V
		—	–2	mA	V_{CC} = 2.3 to 2.7 V
		—	–6		V_{CC} = 3.0 to 3.6 V
		—	–12		V_{CC} = 4.5 to 5.5 V
	I_{OL}	—	50	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	V	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_I, or V_O = 0 V to 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}	—	11.8	17.7	1.0	20.5	ns	C_L = 15 pF	$\overline{CLK}$	Q_A
		—	15.1	21.3	1.0	24.5		C_L = 50 pF		
		—	13.4	20.3	1.0	23.5		C_L = 15 pF		Q_B
		—	16.7	23.9	1.0	27.5		C_L = 50 pF		
		—	14.9	22.5	1.0	26.0		C_L = 15 pF		Q_C
		—	18.2	26.1	1.0	30.0		C_L = 50 pF		
		—	16.2	24.2	1.0	28.0		C_L = 15 pF		Q_D
		—	19.5	27.8	1.0	32.0		C_L = 50 pF		
	t_{PHL}	—	10.8	14.8	1.0	17.0		C_L = 15 pF	CLR	Q_n
		—	14.2	17.4	1.0	20.0		C_L = 50 pF		
Setup time	t_{su}	6.0	—	—	6.0	—	ns		CLR L before $\overline{CLK}$ ↓	
Pulse width	t_w	5.0	—	—	5.0	—	ns		CLR H	
		5.0	—	—	5.0	—			$\overline{CLK}$ H or 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	75	120	—	65	—	MHz	C_L = 15 pF		
		45	65	—	35	—		C_L = 50 pF		
Propa-gation delay time	t_{PLH}/t_{PHL}	—	8.6	13.2	1.0	15.5	ns	C_L = 15 pF	$\overline{CLK}$	Q_A
		—	11.1	16.7	1.0	19.0		C_L = 50 pF		
		—	10.2	15.8	1.0	18.5		C_L = 15 pF		Q_B
		—	12.7	19.3	1.0	22.0		C_L = 50 pF		
		—	11.7	18.0	1.0	21.0		C_L = 15 pF		Q_C
		—	14.2	21.5	1.0	24.5		C_L = 50 pF		
		—	13.0	19.7	1.0	23.0		C_L = 15 pF		Q_D
		—	15.5	23.2	1.0	26.5		C_L = 50 pF		
	t_{PHL}	—	7.9	12.3	1.0	14.5		C_L = 15 pF	CLR	Q_n
		—	10.4	15.8	1.0	18.0		C_L = 50 pF		
Setup time	t_{su}	5.0	—	—	5.0	—	ns		CLR L before $\overline{CLK}\downarrow$	
Pulse width	t_w	5.0	—	—	5.0	—	ns		CLR H	
		5.0	—	—	5.0	—			$\overline{CLK}$ H or L	

Switching Characteristics (cont)

- **V_{CC} = 5.0 ± 0.5 V**

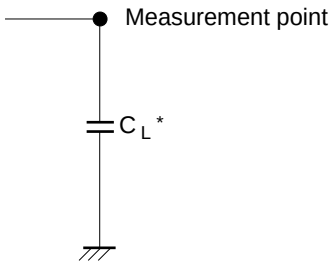
		Ta = 25°C			Ta = –40 to 85°C					
Item	**Symbol**	**Min**	**Typ**	**Max**	**Min**	**Max**	**Unit**	**Test Conditions**	**FROM (Input)**	**TO (Output)**
Maximum clock frequency	fmax	125	170	—	105	—	MHz	C_L = 15 pF		
		85	115	—	75	—		C_L = 50 pF		
Propa-gation delay time	t_{PLH}/t_{PHL}	—	5.8	8.5	1.0	10.0	ns	C_L = 15 pF	$\overline{CLK}$	Q_A
		—	7.3	10.5	1.0	12.0		C_L = 50 pF		
		—	6.8	9.8	1.0	11.5		C_L = 15 pF		Q_B
		—	8.3	11.8	1.0	13.5		C_L = 50 pF		
		—	7.7	11.2	1.0	13.0		C_L = 15 pF		Q_C
		—	9.2	13.2	1.0	15.0		C_L = 50 pF		
		—	8.5	12.5	1.0	14.5		C_L = 15 pF		Q_D
		—	10.0	14.5	1.0	16.5		C_L = 50 pF		
	t_{PHL}	—	5.4	8.1	1.0	9.5		C_L = 15 pF	CLR	Q_n
		—	6.9	10.1	1.0	11.5		C_L = 50 pF		
Setup time	t_{su}	4.0	—	—	4.0	—	ns		CLR L before $\overline{CLK}$ ↓	
Pulse width	t_w	5.0	—	—	5.0	—	ns		CLR H	
		5.0	—	—	5.0	—			$\overline{CLK}$ H or L	

Operating Characteristics

- **C_L = 50 pF**

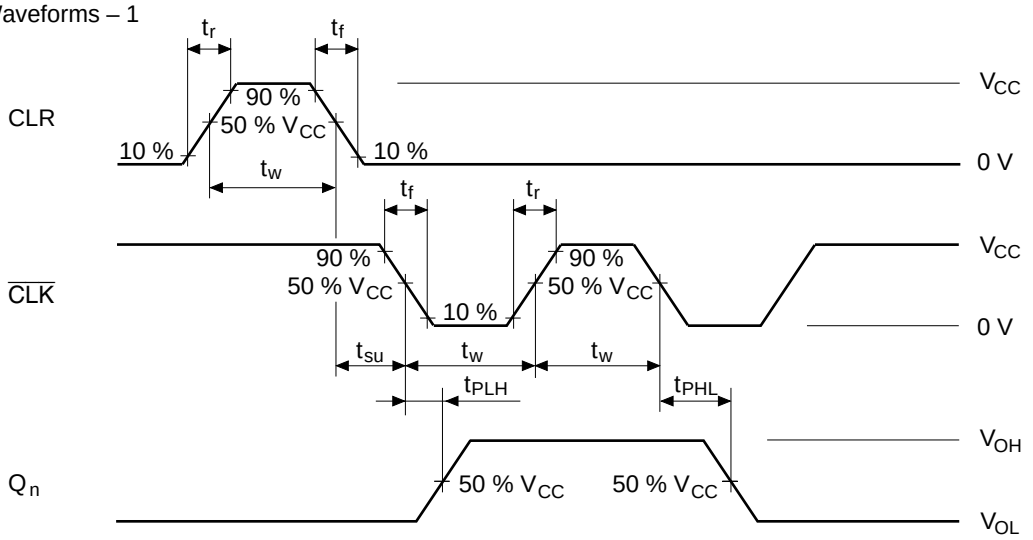
Item	Symbol	V_{cc} (V)	Ta = 25°C Min	Typ	Max	Unit	Test Conditions
Power dissipation capacitance	C_{PD}	3.3	—	12.0	—	pF	f = 10 MHz
		5.0	—	15.0	—		

Test Circuit

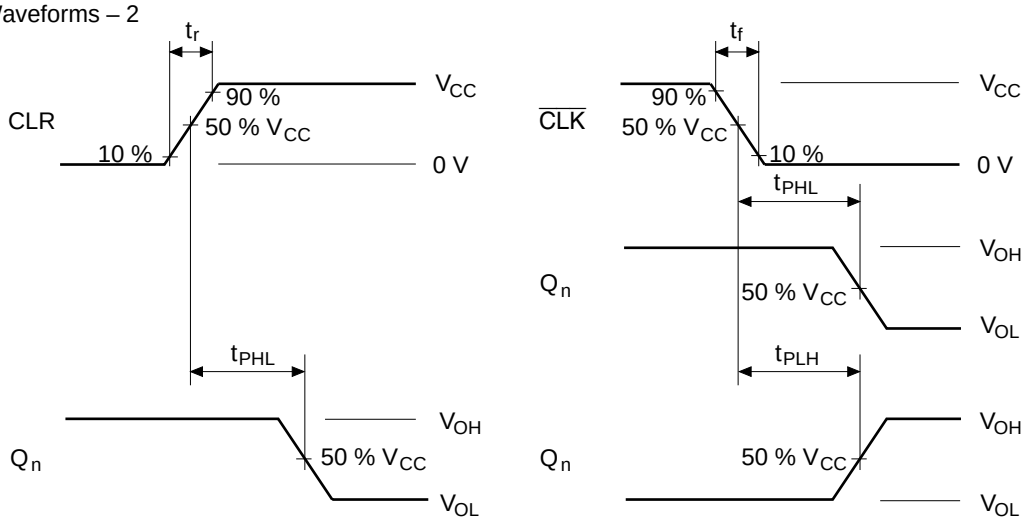


Note: C_L includes the probe and jig capacitance.

• Waveforms – 1

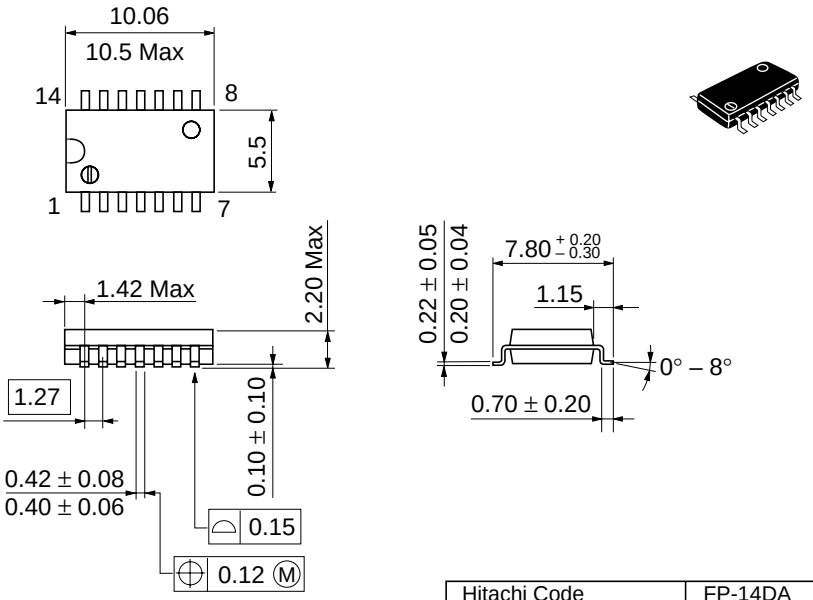


• Waveforms – 2



Notes: 1. Input waveform: PRR ≤ 10 MHz, Zo = 50 Ω, t_r ≤ 3 ns, t_f ≤ 3 ns
2. The output are measured one at a time with one transition per measurement.

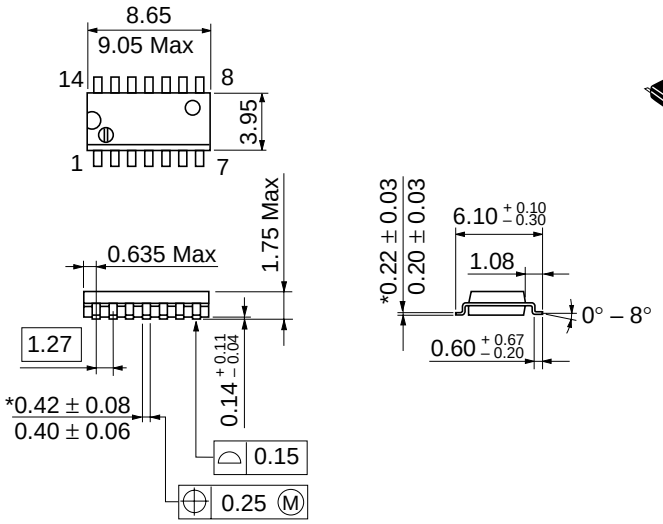
Package Dimensions



Dimension including the plating thickness
Base material dimension

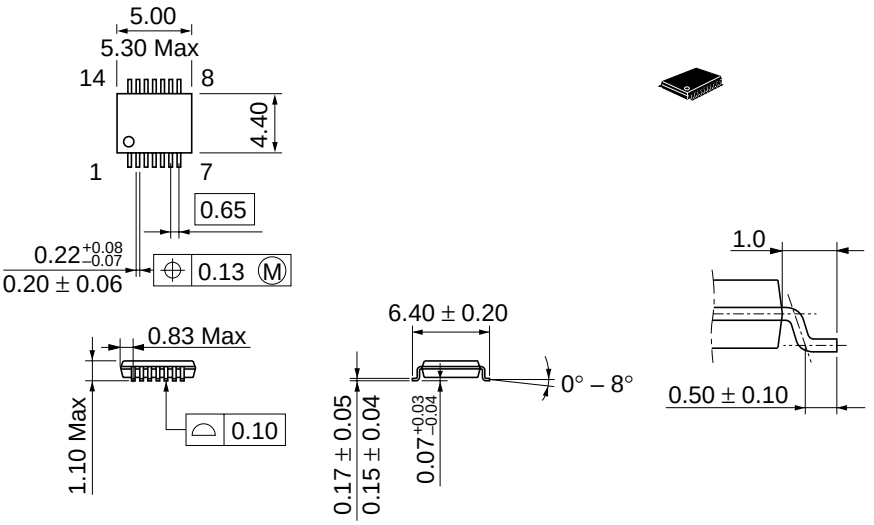
Hitachi Code	FP-14DA
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.23 g

Unit: mm



*Dimension including the plating thickness
Base material dimension

Hitachi Code	FP-14DN
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	0.13 g



Dimension including the plating thickness
Base material dimension

Hitachi Code	TTP-14D
JEDEC	—
EIAJ	—
Weight (reference value)	0.05 g

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