

# HD74LV163A

## Synchronous 4-bit Binary Counter (Synchronous Clear)

REJ03D0320-0500Z  
(Previous ADE-205-265C (Z))  
Rev.5.00  
Jun. 04, 2004

### Description

The HD74LV163A 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  $5.5\text{ V}$ )
- Ordering Information

Part Name	Package Type	Package Code	Package Abbreviation	Taping Abbreviation (Quantity)
HD74LV163AFPEL	SOP-16 pin(JEITA)	FP-16DAV	FP	EL (2,000 pcs/reel)
HD74LV163ARPEL	SOP-16 pin(JEDEC)	FP-16DNV	RP	EL (2,500 pcs/reel)
HD74LV163ATELL	TSSOP-16 pin	TTP-16DAV	T	ELL (2,000 pcs/reel)

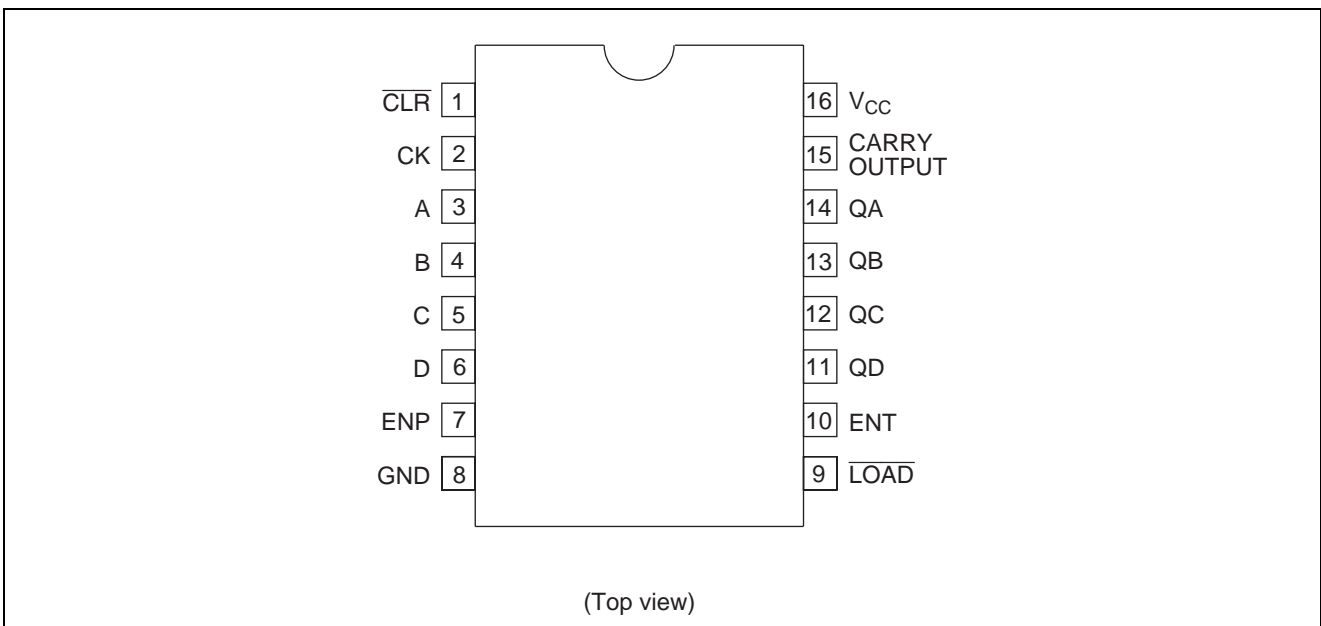
Note: Please consult the sales office for the above package availability.

**Function Table**

Inputs					Outputs			
CLR	LOAD	ENP	ENT	CLK	QA	QB	QC	QD
L	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			
X	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**



### 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	
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>	$P_T$	785 500	mW	SOP 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.

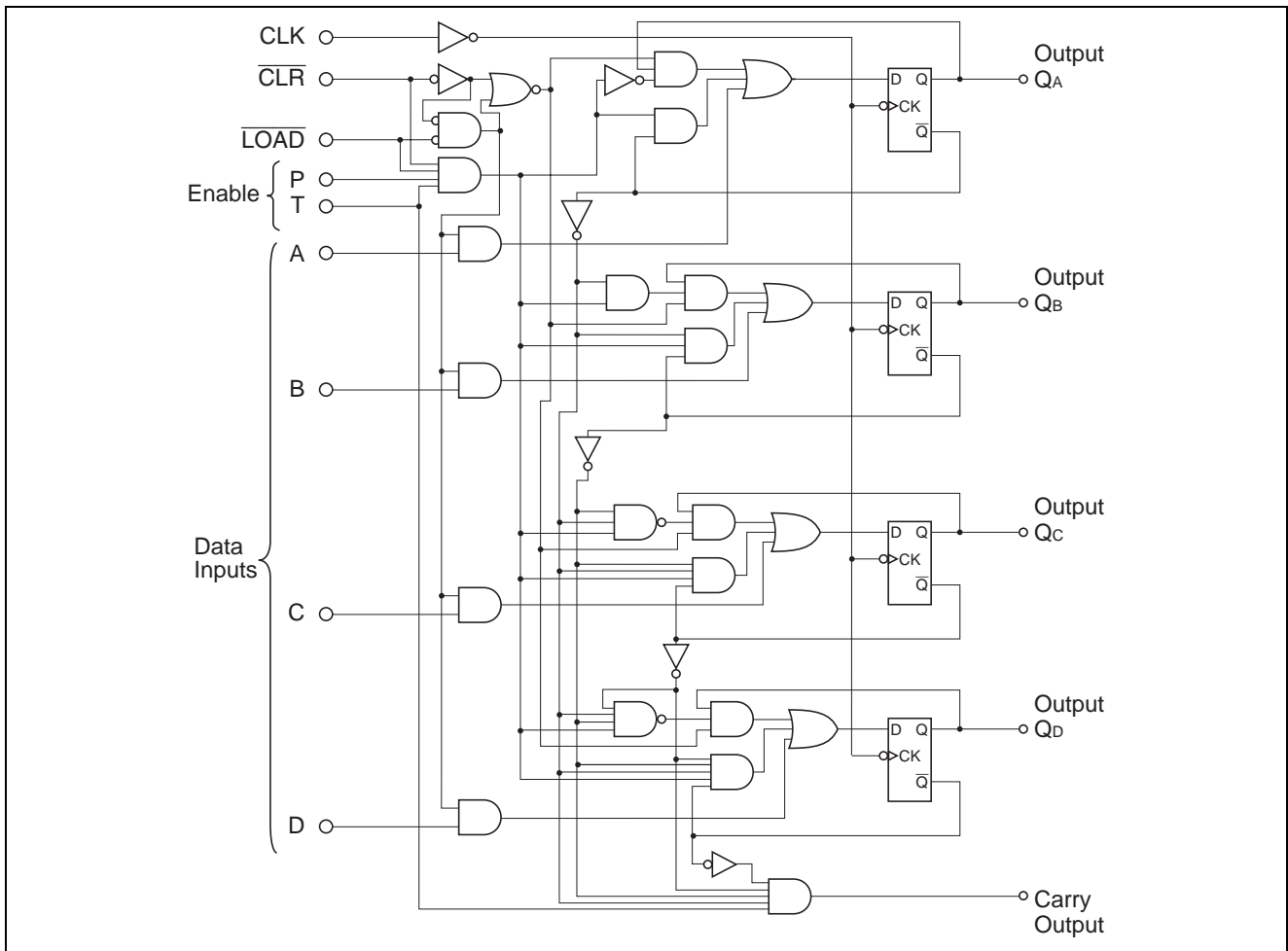
1. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. This value is limited to 5.5 V maximum.
3. The maximum package power dissipation was calculated using a junction temperature of 150°C.

### Recommended Operating Conditions

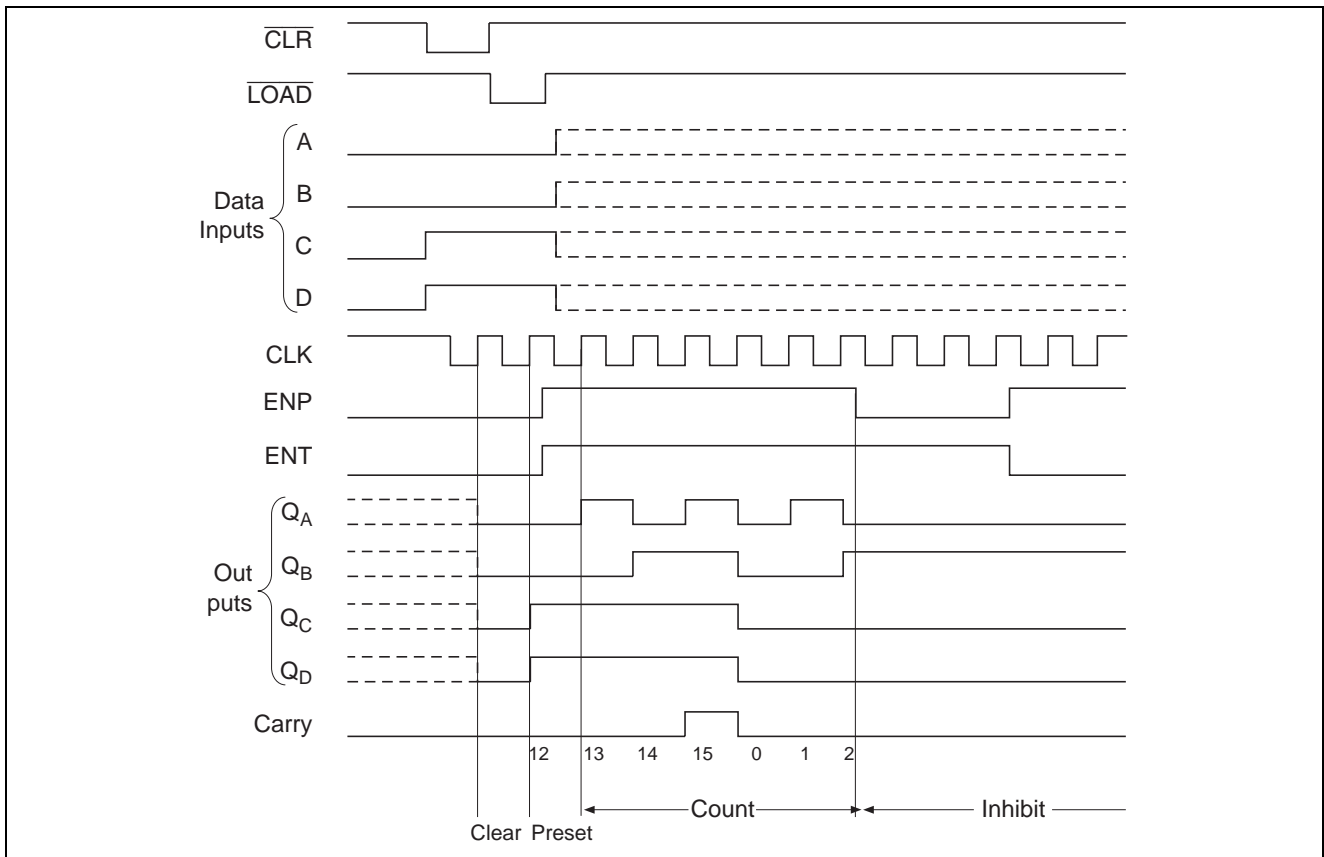
Item	Symbol	Min	Max	Unit	Conditions
Supply voltage range	$V_{CC}$	2.0	5.5	V	
Input voltage range	$V_I$	0	5.5	V	
Output voltage range	$V_O$	0	$V_{CC}$	V	H or L
Output current	$I_{OH}$	—	-50	$\mu\text{A}$	$V_{CC} = 2.0\text{ V}$
		—	-2	mA	$V_{CC} = 2.3$ to $2.7\text{ V}$
		—	-6		$V_{CC} = 3.0$ to $3.6\text{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

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 <sub>CC</sub> (V)*	Min	Typ	Max	Unit	Test Conditions			
Input voltage	V <sub>IH</sub>	2.0	1.5	—	—	V				
		2.3 to 2.7	V <sub>CC</sub> × 0.7	—	—					
		3.0 to 3.6	V <sub>CC</sub> × 0.7	—	—					
		4.5 to 5.5	V <sub>CC</sub> × 0.7	—	—					
	V <sub>IL</sub>	2.0	—	—	0.5					
		2.3 to 2.7	—	—	V <sub>CC</sub> × 0.3					
		3.0 to 3.6	—	—	V <sub>CC</sub> × 0.3					
		4.5 to 5.5	—	—	V <sub>CC</sub> × 0.3					
Output voltage	V <sub>OH</sub>	Min to Max	V <sub>CC</sub> - 0.1	—	—	V	I <sub>OL</sub> = -50 μA			
		2.3	2.0	—	—		I <sub>OL</sub> = -2 mA			
		3.0	2.48	—	—		I <sub>OL</sub> = -6 mA			
		4.5	3.8	—	—		I <sub>OL</sub> = -12 mA			
	V <sub>OL</sub>	Min to Max	—	—	0.1		I <sub>OL</sub> = 50 μA			
		2.3	—	—	0.4		I <sub>OL</sub> = 2 mA			
		3.0	—	—	0.44		I <sub>OL</sub> = 6 mA			
		4.5	—	—	0.55		I <sub>OL</sub> = 12 mA			
		Input current	I <sub>IN</sub>	0 to 5.5	—		—	±1	μA	V <sub>IN</sub> = 5.5 V or GND
		Quiescent supply current	I <sub>CC</sub>	5.5	—		—	20	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0
Output leakage current	I <sub>OFF</sub>	0	—	—	5	μA	V <sub>I</sub> or V <sub>O</sub> = 0 V to 5.5 V			
Input capacitance	C <sub>IN</sub>	3.3	—	1.7	—	pF	V <sub>I</sub> = V <sub>CC</sub> or GND			

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

Switching Characteristics

V<sub>CC</sub> = 2.5 ± 0.2 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	f <sub>max</sub>	50	90	—	40	—	MHz	C <sub>L</sub> = 15 pF		
		30	60	—	25	—		C <sub>L</sub> = 50 pF		
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		C <sub>L</sub> = 50 pF		
	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			
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 ↑	
		6.0	—	—	6.0	—			CLR before CLK ↑	
Hold time	t <sub>h</sub>	1.5	—	—	1.5	—	ns			
		1.5	—	—	1.5	—			CLR after CLK ↑	
Pulse width	t <sub>w</sub>	7.0	—	—	7.0	—	ns		CLK H or L	

Switching Characteristics (cont)

V<sub>CC</sub> = 3.3 ± 0.3 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	t <sub>max</sub>	80	130	—	70	—	MHz	C <sub>L</sub> = 15 pF		
		55	85	—	50	—		C <sub>L</sub> = 50 pF		
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		C <sub>L</sub> = 50 pF		
	t <sub>PLH</sub> /t <sub>PHL</sub>	—	8.7	13.6	1.0	16.0	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	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	C <sub>L</sub> = 15 pF	ENT	Carry	
		—	10.5	15.8	1.0	18.0	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 ↑		
		4.0	—	—	4.0	—		CLR before CLK ↑		
Hold time	t <sub>h</sub>	1.0	—	—	1.0	—	ns			
		1.0	—	—	1.0	—		CLR after CLK ↑		
Pulse width	t <sub>w</sub>	5.0	—	—	5.0	—	ns		CLK H or L	

V<sub>CC</sub> = 5.0 ± 0.5 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	t <sub>max</sub>	135	185	—	115	—	MHz	C <sub>L</sub> = 15 pF		
		95	125	—	85	—		C <sub>L</sub> = 50 pF		
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		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	CLK	Carry	
	Count mode	—	6.4	10.1	1.0	11.5	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			
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 ↑		
		3.5	—	—	3.5	—		CLR before CLK ↑		
Hold time	t <sub>h</sub>	1.0	—	—	1.0	—	ns			
		1.5	—	—	1.5	—		CLR after CLK ↑		
Pulse width	t <sub>w</sub>	5.0	—	—	5.0	—	ns		CLK H or L	



**Operating Characteristics**

$C_L = 50 \text{ pF}$

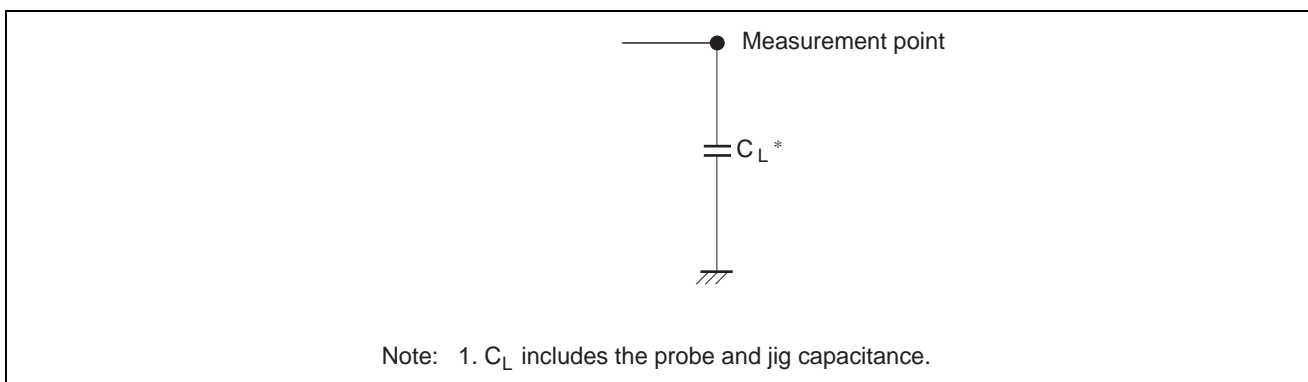
Item	Symbol	$V_{CC} \text{ (V)}$	$T_a = 25^\circ\text{C}$			Unit	Test Conditions
			Min	Typ	Max		
Power dissipation capacitance	$C_{PD}$	3.3	—	17.3	—	pF	f = 10 MHz
		5.0	—	20.6	—		

**Noise Characteristics**

$C_L = 50 \text{ pF}$

Item	Symbol	$V_{CC} \text{ (V)}$	$T_a = 25^\circ\text{C}$			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 $V_{OL}$	$V_{OL(N)}$	3.3	—	-0.3	-0.8	V	
Quiet output, minimum dynamic $V_{OH}$	$V_{OH(N)}$	3.3	—	3.0	—	V	
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	V	

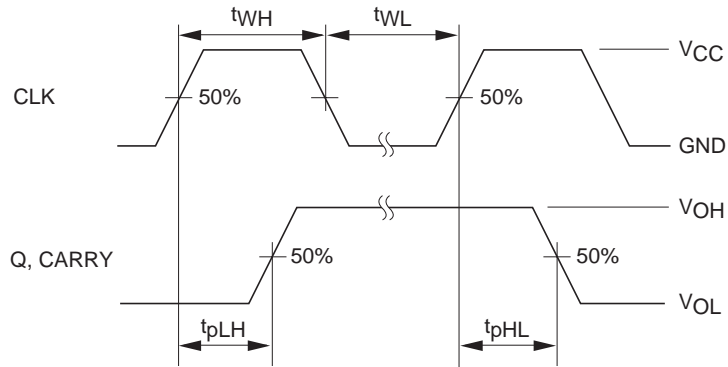
**Test Circuit**



Waveforms

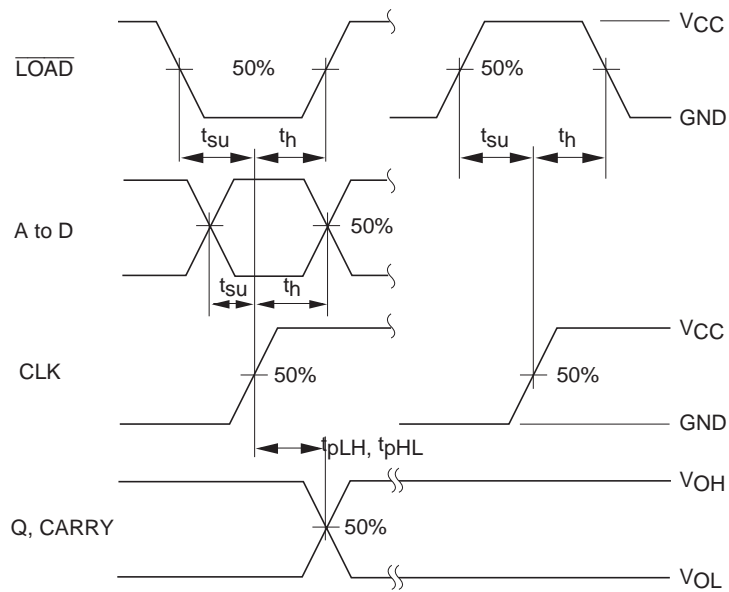
Waveform – 1

Count mode



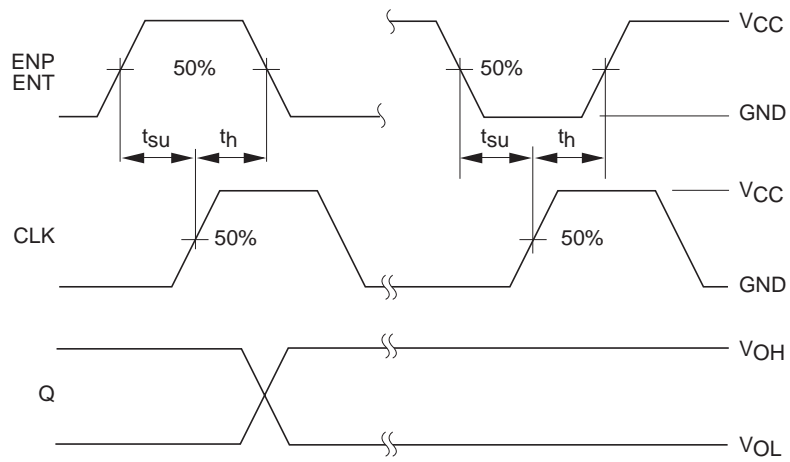
Waveform – 2

Preset mode



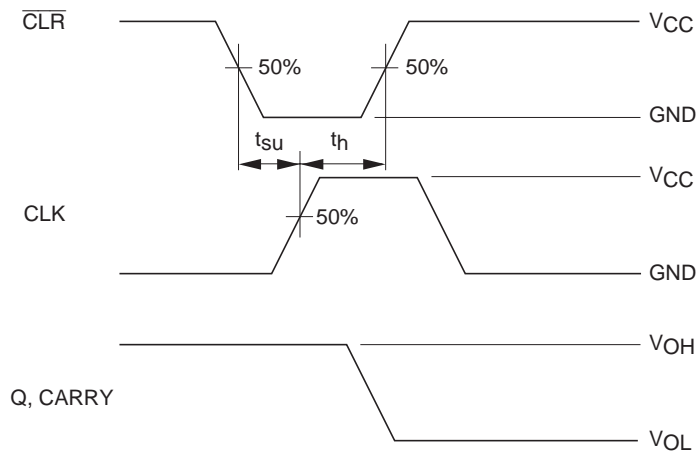
Waveform – 3

Count enable mode

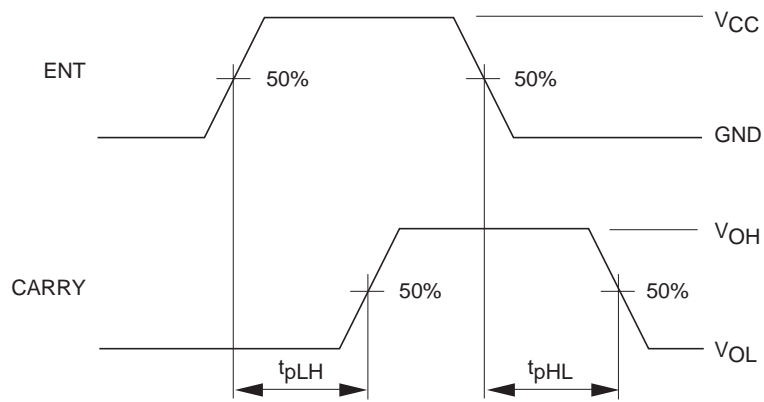


Waveform – 4

Clear mode



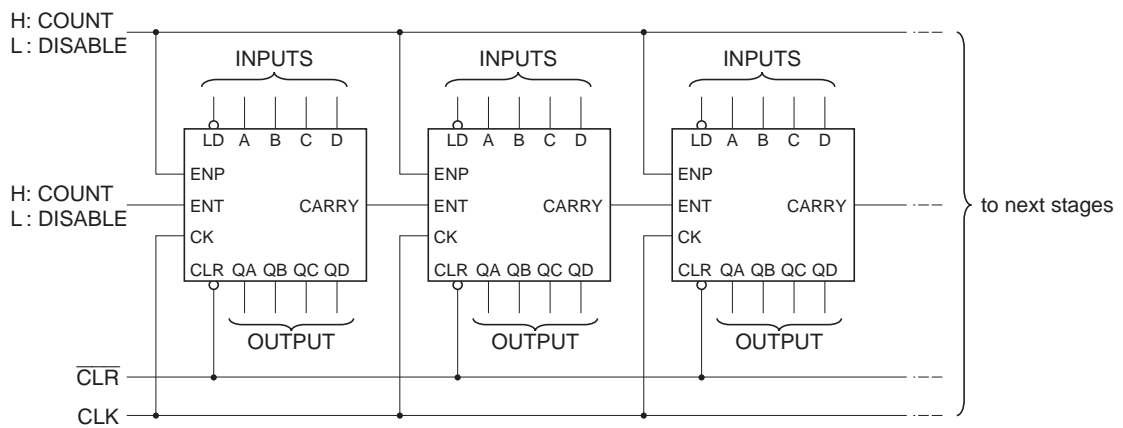
Waveform – 5  
 Cascade mode  
 (set to maximum count number)



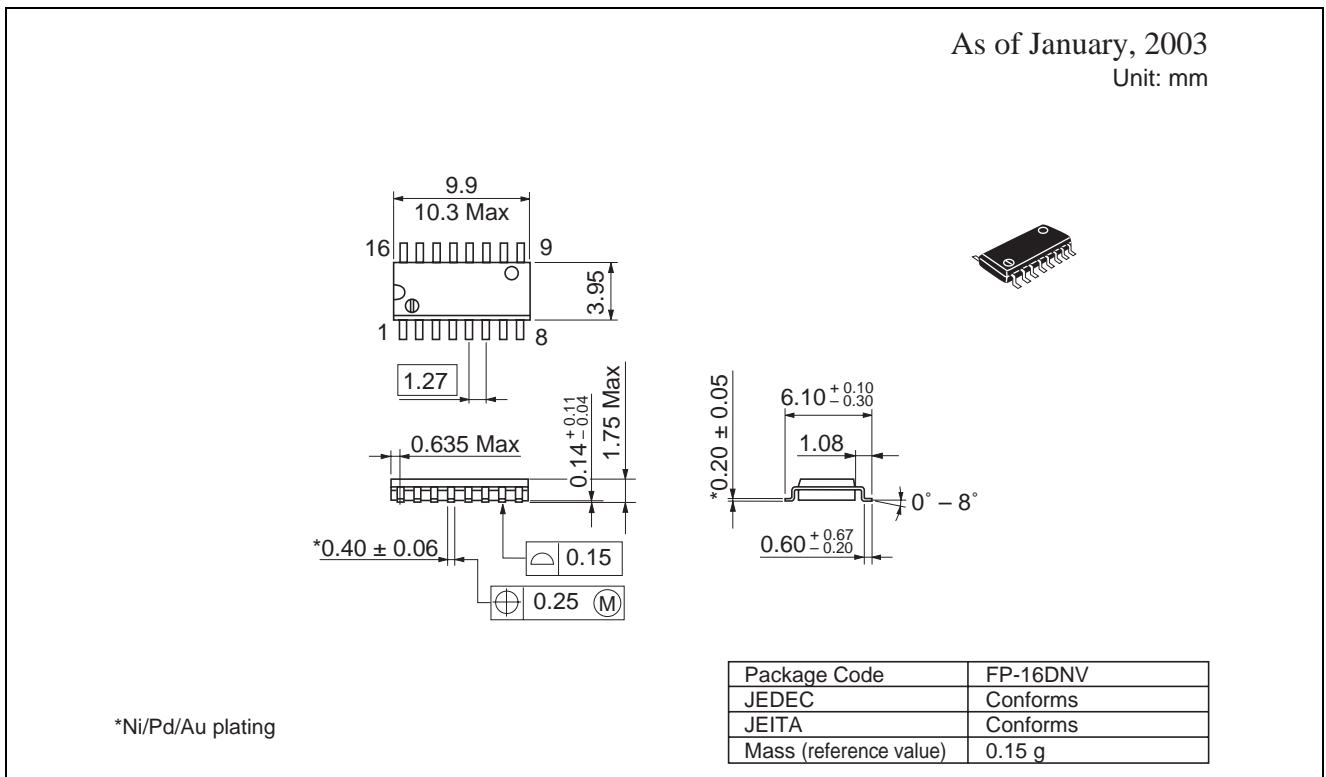
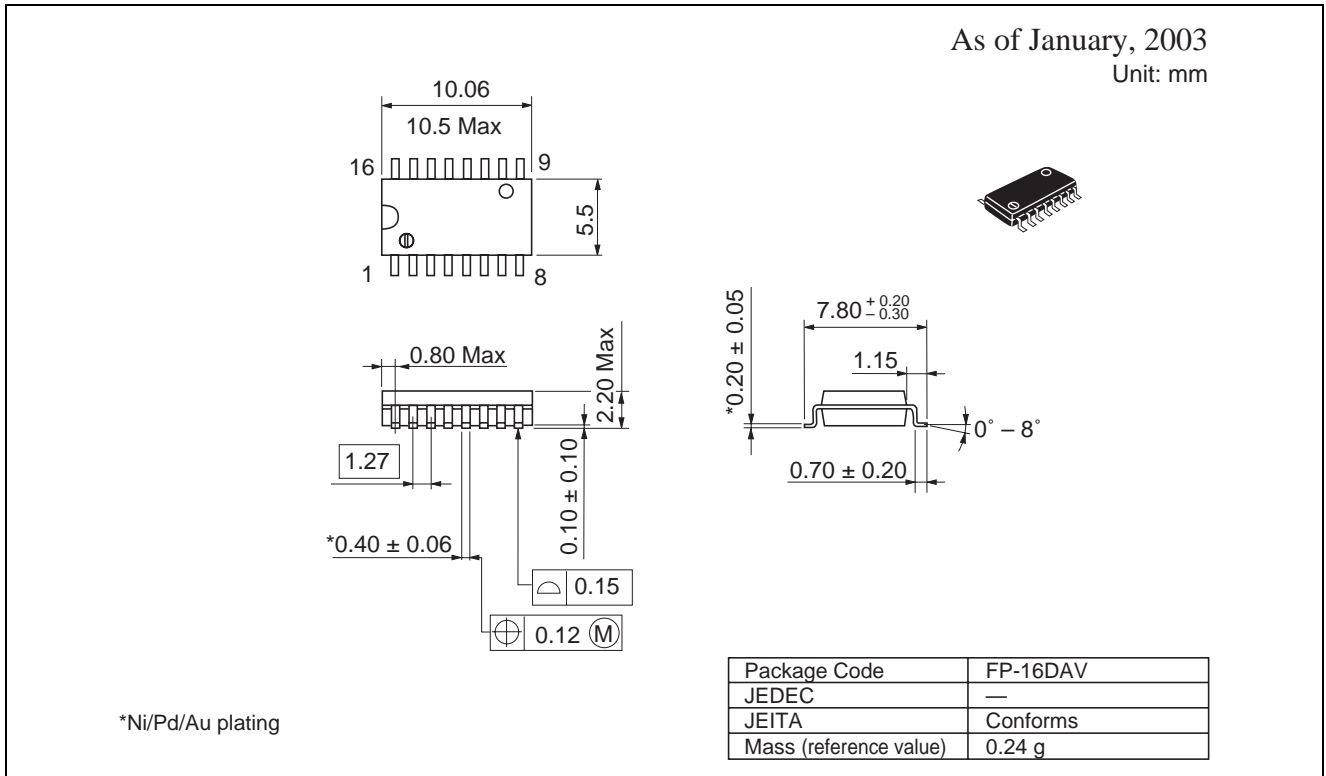
Note: 1. Input waveform:  $PRR \leq 1$  MHz, duty cycle 50%,  $t_r \leq 3$  ns,  $t_f \leq 3$  ns

### Application

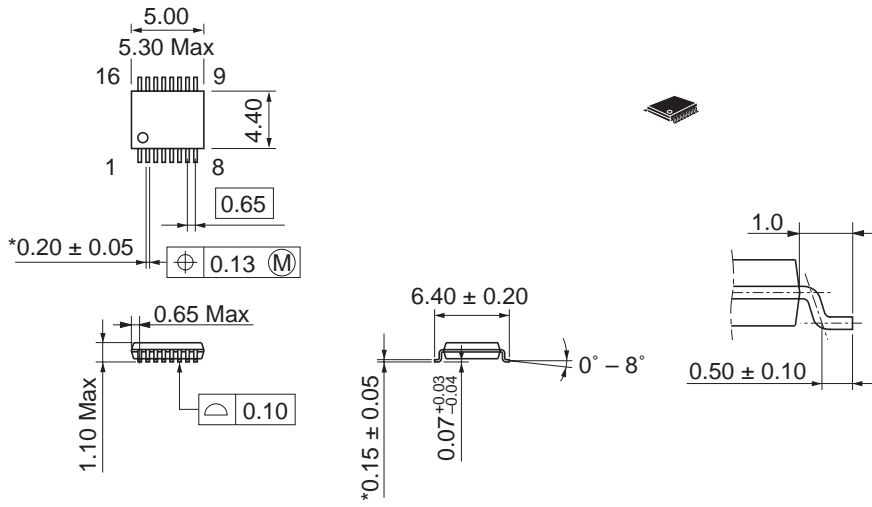
Cascade circuitry



Package Dimensions



As of January, 2003  
Unit: mm



\*Ni/Pd/Au plating

Package Code	TTP-16DAV
JEDEC	—
JEITA	—
Mass (reference value)	0.05 g

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