

# HD74AC283/HD74ACT283

## 4-bit Binary Full Adder with Fast Carry

REJ03D0267-0200Z  
 (Previous ADE-205-388 (Z))  
 Rev.2.00  
 Jul.16.2004

### Description

The HD74AC283/HD74ACT283 high-speed 4-bit binary full adder with internal carry lookahead accepts two 4-bit binary works ( $A_0 - A_3$ ,  $B_0 - B_3$ ) and a Carry input ( $C_0$ ). It generates the binary Sum outputs ( $S_0 - S_3$ ) and the Carry output ( $C_4$ ) from the most significant bit. The HD74AC283/HD74ACT283 will operate with either active High or active Low operands (positive or negative logic).

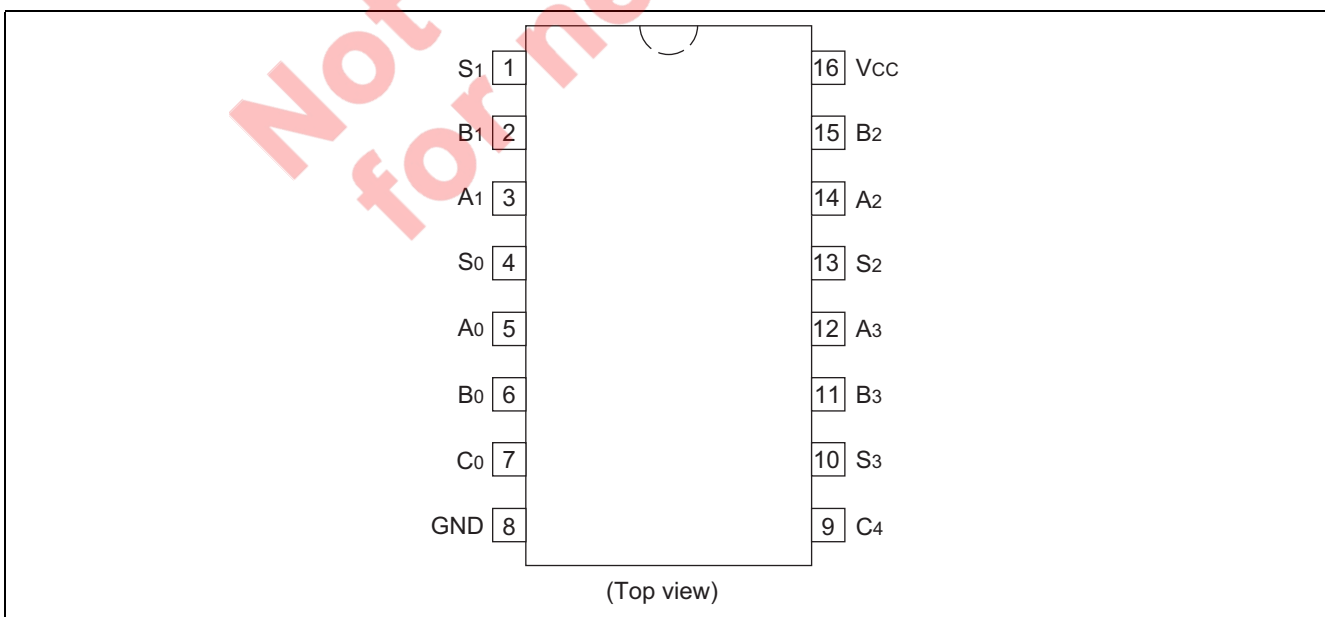
### Features

- Outputs Source/Sink 24 mA
- HD74ACT283 has TTL-Cmpatible Inputs
- Ordering Information: Ex. HD74AC283

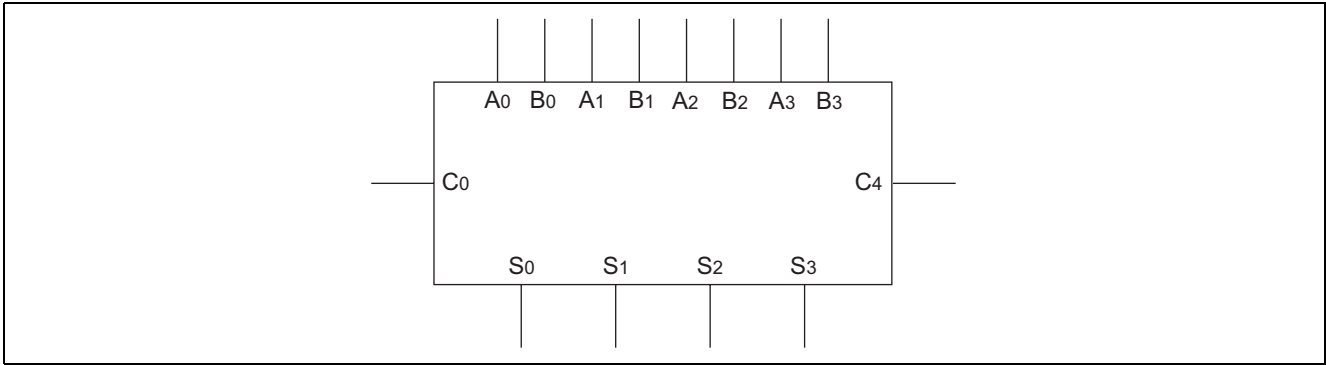
Part Name	Package Type	Package Code	Package Abbreviation	Taping Abbreviation (Quantity)
HD74AC283AP	DIP-16 pin	DP-16E, -16FV	P	—
HD74AC283AFPEL	SOP-16 pin (JEITA)	FP-16DAV	FP	EL (2,000 pcs/reel)
HD74AC283ARPEL	SOP-16 pin (JEDEC)	FP-16DNV	RP	EL (2,500 pcs/reel)
HD74AC283TELL	TSSOP-16 pin	TTP-16DAV	T	ELL(2,000 pcs/reel)

- Notes: 1. Please consult the sales office for the above package availability.  
 2. The packages with lead-free pins are distinguished from the conventional products by adding V at the end of the package code.

### Pin Arrangement



**Logic Symbol**



**Pin Names**

- A<sub>0</sub> – A<sub>3</sub> A Operand Inputs
- B<sub>0</sub> – B<sub>3</sub> B Operand Inputs
- C<sub>0</sub> Carry Input
- S<sub>0</sub> – S<sub>3</sub> Sum Outputs
- C<sub>4</sub> Carry Output

**Functional Description**

The HD74AC283/HD74ACT283 adds two 4-bit binary words (A plus B) plus the incoming Carry (C<sub>0</sub>). The binary sum appears on the Sum (S<sub>0</sub> – S<sub>3</sub>) and outgoing carry (C<sub>4</sub>) outputs. The binary weight of the various inputs and outputs is indicated by the subscript numbers, representing powers of two.

$$2^0 (A_0 + B_0 + C_0) + 2^1 (A_1 + B_1) + 2^2 (A_2 + B_2) + 2^3 (A_3 + B_3) = S_0 + 2S_1 + 4S_2 + 8S_3 + 16C_4$$

Where (+) = plus

Interchanging inputs of equal weight does not affect the operation. Thus C<sub>0</sub>, A<sub>0</sub>, B<sub>0</sub> can be arbitrarily assigned to pins 5, 6 and 7 for DIPS. Due to the symmetry of the binary add function, the HD74AC283/HD74ACT283 can be used either with all inputs and outputs active High (positive logic) or with all inputs and outputs active Low (negative logic). See Figure a. Note that if C<sub>0</sub> is not used it must be tied Low for active High logic or tied High for active Low logic.

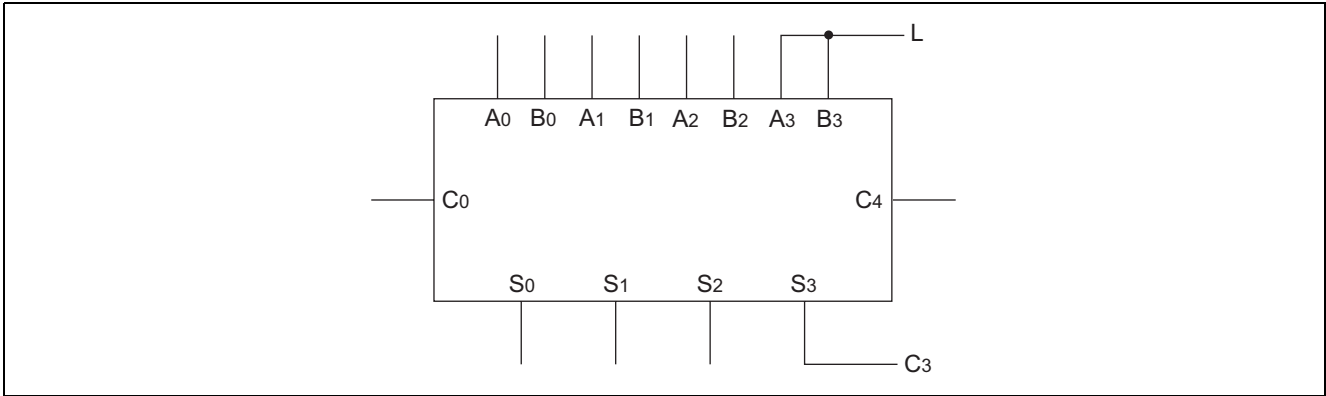
Due to pin limitations, the intermediate carries of the HD74AC283/HD74ACT283 are not brought out for use as inputs or outputs. However, other means can be used to effectively insert a carry into, or bring a carry out from, an intermediate stage. Figure b shows how to make a 3-bit adder. Tying the operand inputs of the fourth adder (A<sub>3</sub>, B<sub>3</sub>) Low makes S<sub>3</sub> dependent only on, and equal to, the carry from the third adder. Using somewhat the same principle Figure c shows a way of dividing the HD74AC283/HD74ACT283 into a 2-bit and a 1-bit adder. The third stage adder (A<sub>2</sub>, B<sub>2</sub>, S<sub>2</sub>) is used merely as a means of getting a carry (C<sub>10</sub>) signal into the fourth stage (via A<sub>2</sub> and B<sub>2</sub>) and bringing out the carry from the second stage on S<sub>2</sub>. Note that as long as A<sub>2</sub> and B<sub>2</sub> are the same, whether High or Low, they do not influence S<sub>2</sub>. Similarly, when A<sub>2</sub> and B<sub>2</sub> are the same the carry into the third stage does not influence the carry out of the third stage. Figure d shows a method of implementing a 5-input encoder, where the inputs are equally weighted. The outputs S<sub>0</sub>, S<sub>1</sub> and S<sub>2</sub> present a binary number equal to the number of inputs I<sub>1</sub> – I<sub>5</sub> that are true. Figure e shows one method of implementing a 5-input majority gate. When three or more of the inputs I<sub>1</sub> – I<sub>5</sub> are true, the output M<sub>5</sub> is true.

**Fig. a Active HIGH versus Active LOW Interpretation**

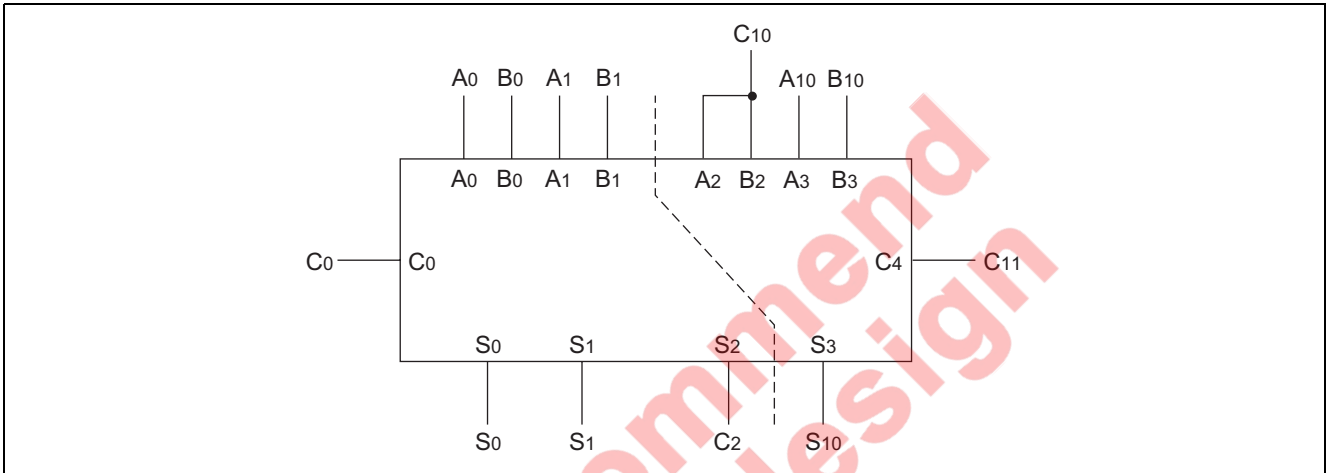
	C <sub>0</sub>	A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	B <sub>0</sub>	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	S <sub>0</sub>	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	C <sub>4</sub>
Logic levels	L	L	H	L	H	H	L	L	H	H	H	L	L	H
Active HIGH	0	0	1	0	1	1	0	0	1	1	1	0	0	1
Active LOW	1	1	0	1	0	0	1	1	0	0	0	1	1	0

Active HIGH: 0 + 10 + 9 = 3 + 16

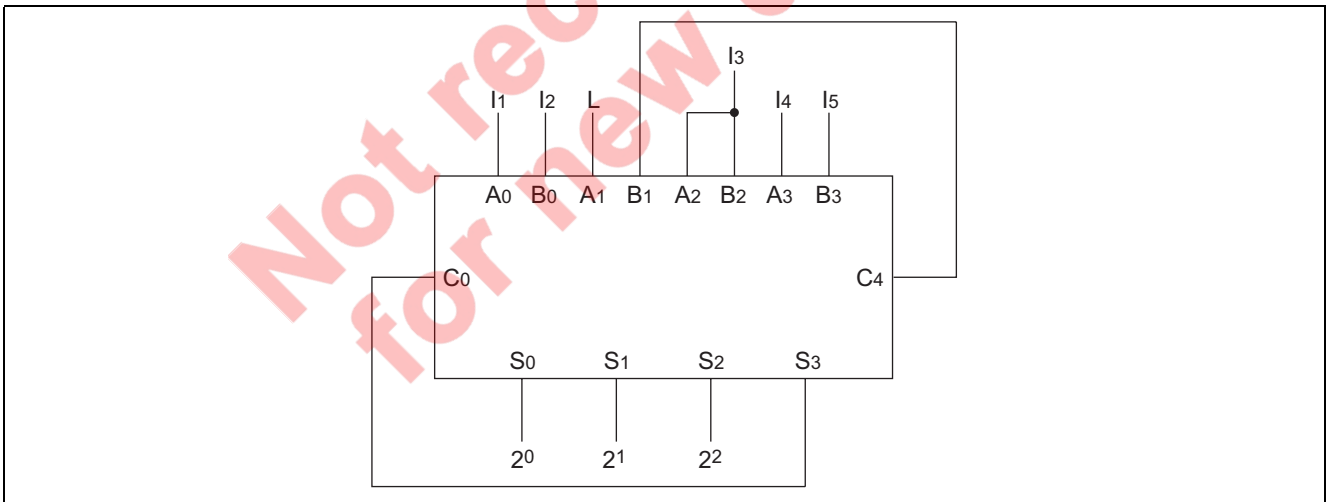
Active LOW: 1 + 5 + 6 = 12 + 0



**Fig. b 3-bit Adder**



**Fig. c 2-bit and 1-bit adders**



**Fig. d 5-Input Encoder**

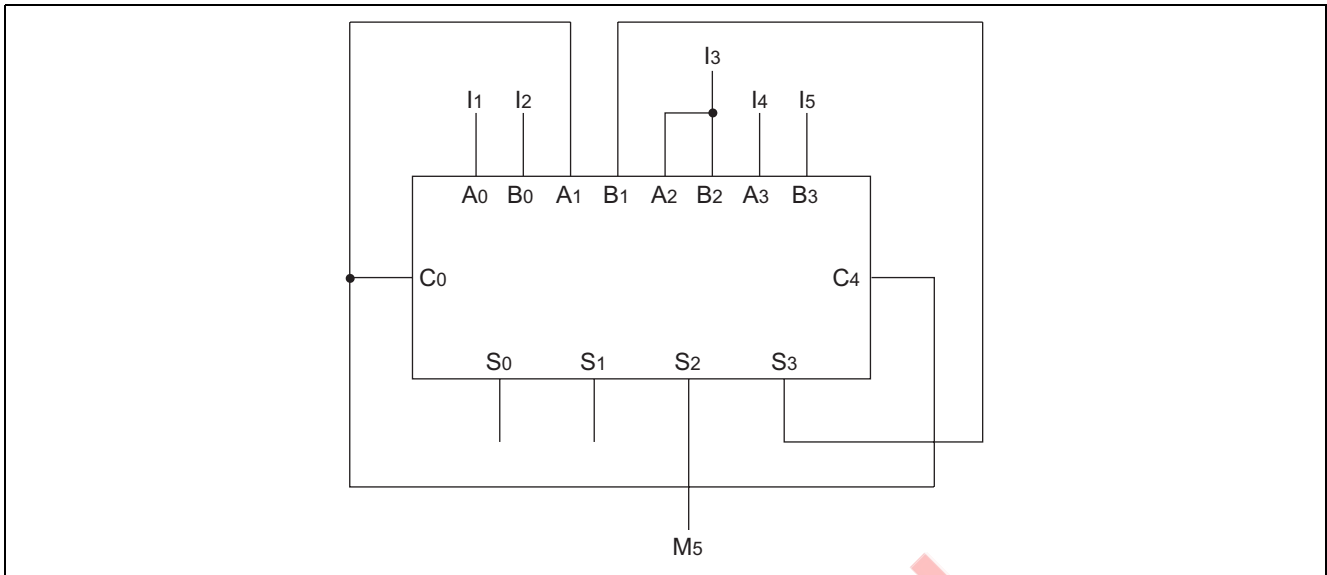
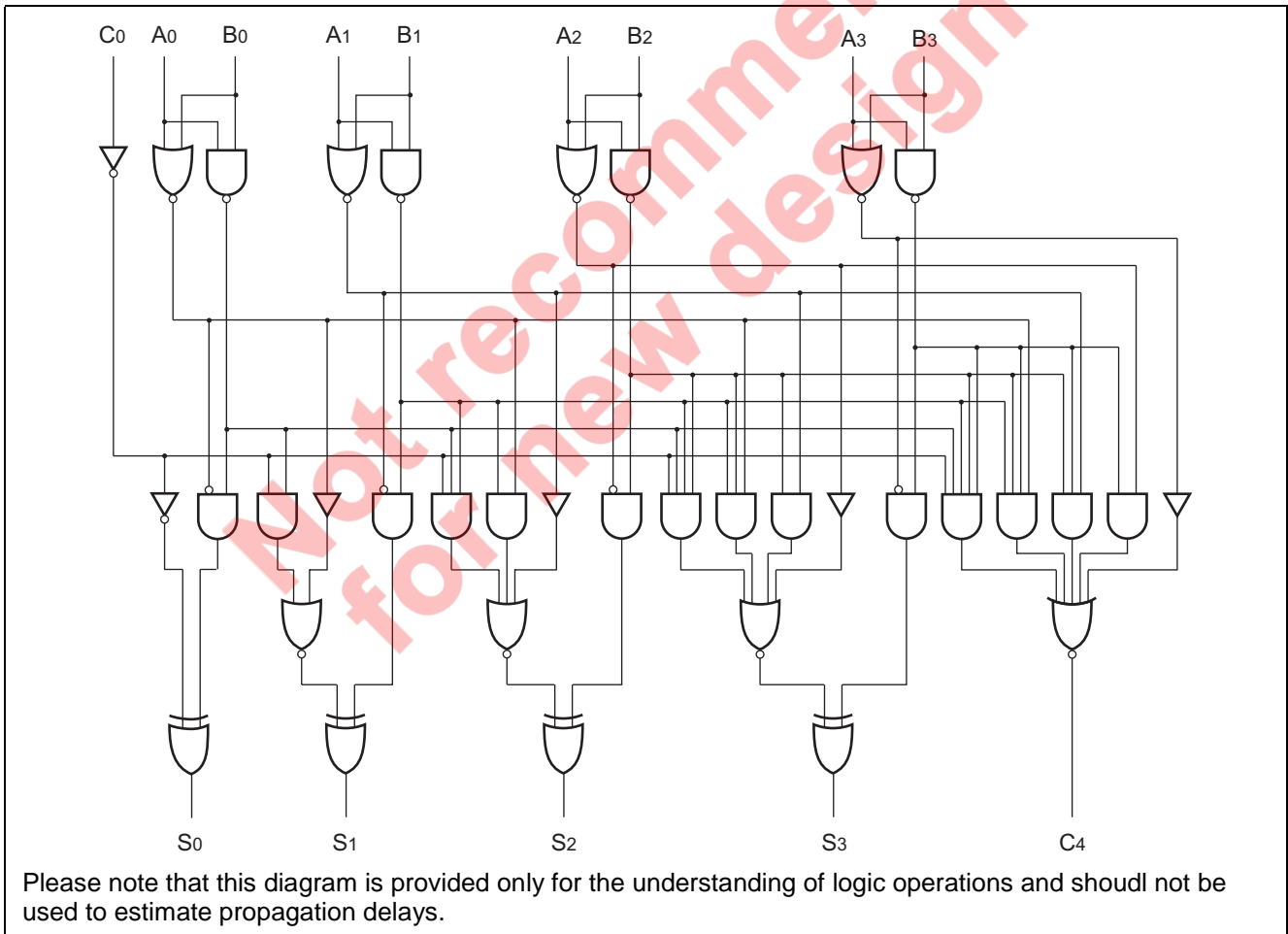


Fig. e 5-Input Majority Gate

Logic Diagram



**Absolute Maximum Ratings**

Item	Symbol	Ratings	Unit	Condition
Supply voltage	$V_{CC}$	-0.5 to 7	V	
DC input diode current	$I_{IK}$	-20	mA	$V_I = -0.5V$
		20	mA	$V_I = V_{CC}+0.5V$
DC input voltage	$V_I$	-0.5 to $V_{CC}+0.5$	V	
DC output diode current	$I_{OK}$	-50	mA	$V_O = -0.5V$
		50	mA	$V_O = V_{CC}+0.5V$
DC output voltage	$V_O$	-0.5 to $V_{CC}+0.5$	V	
DC output source or sink current	$I_O$	$\pm 50$	mA	
DC $V_{CC}$ or ground current per output pin	$I_{CC}, I_{GND}$	$\pm 50$	mA	
Storage temperature	$T_{stg}$	-65 to +150	$^{\circ}C$	

**Recommended Operating Conditions: HD74AC283**

Item	Symbol	Ratings	Unit	Condition
Supply voltage	$V_{CC}$	2 to 6	V	
Input and output voltage	$V_I, V_O$	0 to $V_{CC}$	V	
Operating temperature	$T_a$	-40 to +85	$^{\circ}C$	
Input rise and fall time (except Schmitt inputs) $V_{IN}$ 30% to 70% $V_{CC}$	tr, tf	8	ns/V	$V_{CC} = 3.0V$
				$V_{CC} = 4.5 V$
				$V_{CC} = 5.5 V$

**DC Characteristics: HD74AC283**

Item	Sym- bol	$V_{CC}$ (V)	$T_a = 25^{\circ}C$			$T_a = -40$ to $+85^{\circ}C$		Unit	Condition			
			min.	typ.	max.	min.	max.					
Input Voltage	$V_{IH}$	3.0	2.1	1.5	—	2.1	—	V	$V_{OUT} = 0.1 V$ or $V_{CC} - 0.1 V$			
		4.5	3.15	2.25	—	3.15	—					
		5.5	3.85	2.75	—	3.85	—					
	$V_{IL}$	3.0	—	1.50	0.9	—	0.9			V	$V_{OUT} = 0.1 V$ or $V_{CC} - 0.1 V$	
		4.5	—	2.25	1.35	—	1.35					
		5.5	—	2.75	1.65	—	1.65					
Output voltage	$V_{OH}$	3.0	2.9	2.99	—	2.9	—	V	$V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OUT} = -50 \mu A$			
		4.5	4.4	4.49	—	4.4	—					
		5.5	5.4	5.49	—	5.4	—					
		3.0	2.58	—	—	2.48	—			$V_{IN} = V_{IL}$ or $V_{IH}$	$I_{OH} = -12 mA$	
		4.5	3.94	—	—	3.80	—				$I_{OH} = -24 mA$	
		5.5	4.94	—	—	4.80	—				$I_{OH} = -24 mA$	
	$V_{OL}$	3.0	—	0.002	0.1	—	0.1		V	$V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OUT} = 50 \mu A$		
		4.5	—	0.001	0.1	—	0.1					
		5.5	—	0.001	0.1	—	0.1					
		3.0	—	—	0.32	—	0.37				$V_{IN} = V_{IL}$ or $V_{IH}$	$I_{OL} = 12 mA$
		4.5	—	—	0.32	—	0.37					$I_{OL} = 24 mA$
		5.5	—	—	0.32	—	0.37					$I_{OL} = 24 mA$
Input leakage current	$I_{IN}$	5.5	—	—	$\pm 0.1$	—	$\pm 1.0$	$\mu A$	$V_{IN} = V_{CC}$ or GND			
Dynamic output current*	$I_{OLD}$	5.5	—	—	—	86	—	mA	$V_{OLD} = 1.1 V$			
	$I_{OHD}$	5.5	—	—	—	-75	—	mA	$V_{OHD} = 3.85 V$			
Quiescent supply current	$I_{CC}$	5.5	—	—	8.0	—	80	$\mu A$	$V_{IN} = V_{CC}$ or ground			

\*Maximum test duration 2.0 ms, one output loaded at a time.

**Recommended Operating Conditions: HD74ACT283**

Item	Symbol	Ratings	Unit	Condition
Supply voltage	$V_{CC}$	2 to 6	V	
Input and output voltage	$V_I, V_O$	0 to $V_{CC}$	V	
Operating temperature	$T_a$	-40 to +85	°C	
Input rise and fall time (except Schmitt inputs) $V_{IN}$ 0.8 to 2.0 V	$t_r, t_f$	8	ns/V	$V_{CC} = 4.5V$ $V_{CC} = 5.5V$

**DC Characteristics: HD74ACT283**

Item	Sym- bol	$V_{CC}$ (V)	$T_a = 25^\circ C$			$T_a = -40$ to $+85^\circ C$		Unit	Condition		
			min.	typ.	max.	min.	max.				
Input voltage	$V_{IH}$	4.5	2.0	1.5	—	2.0	—	V	$V_{OUT} = 0.1 V$ or $V_{CC}-0.1 V$		
		5.5	2.0	1.5	—	2.0	—				
	$V_{IL}$	4.5	—	1.5	0.8	—	0.8	V	$V_{OUT} = 0.1 V$ or $V_{CC}-0.1 V$		
		5.5	—	1.5	0.8	—	0.8				
Output voltage	$V_{OH}$	4.5	4.4	4.49	—	4.4	—	V	$V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OUT} = -50 \mu A$		
		5.5	5.4	5.49	—	5.4	—				
		4.5	3.94	—	—	3.80	—			$V_{IN} = V_{IL}$	$I_{OH} = -24 mA$
		5.5	4.94	—	—	4.80	—				$I_{OH} = -24 mA$
	$V_{OL}$	4.5	—	0.001	0.1	—	0.1	V	$V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OUT} = 50 \mu A$		
		5.5	—	0.001	0.1	—	0.1				
		4.5	—	—	0.32	—	0.37			$V_{IN} = V_{IL}$	$I_{OL} = 24 mA$
		5.5	—	—	0.32	—	0.37				$I_{OL} = 24 mA$
	Input current	$I_{IN}$	5.5	—	—	$\pm 0.1$	—	$\pm 1.0$	$\mu A$	$V_{IN} = V_{CC}$ or GND	
	$I_{CC}$ /input current	$I_{CCT}$	5.5	—	0.6	—	—	1.5	mA	$V_{IN} = V_{CC}-2.1 V$	
Dynamic output current*	$I_{OLD}$	5.5	—	—	—	86	—	mA	$V_{OLD} = 1.1 V$		
	$I_{OHD}$	5.5	—	—	—	-75	—	mA	$V_{OHD} = 3.85 V$		
Quiescent supply current	$I_{CC}$	5.5	—	—	8.0	—	80	$\mu A$	$V_{IN} = V_{CC}$ or ground		

\*Maximum test duration 2.0 ms, one output loaded at a time.

## AC Characteristics: HD74AC283

Item	Symbol	V <sub>CC</sub> (V)*1	Ta = +25°C C <sub>L</sub> = 50 pF			Ta = -40°C to +85°C C <sub>L</sub> = 50 pF		Unit
			Min	Typ	Max	Min	Max	
Propagation delay C <sub>0</sub> to S <sub>n</sub>	t <sub>PLH</sub>	3.3	1.0	11.5	15.0	1.0	16.5	ns
		5.0	1.0	9.5	11.5	1.0	12.5	
Propagation delay C <sub>0</sub> to S <sub>n</sub>	t <sub>PHL</sub>	3.3	1.0	10.5	14.0	1.0	15.5	ns
		5.0	1.0	8.5	10.5	1.0	11.5	
Propagation delay A <sub>n</sub> or B <sub>n</sub> to S <sub>n</sub>	t <sub>PLH</sub>	3.3	1.0	14.0	17.0	1.0	18.5	ns
		5.0	1.0	11.5	13.5	1.0	14.5	
Propagation delay A <sub>n</sub> or B <sub>n</sub> to S <sub>n</sub>	t <sub>PHL</sub>	3.3	1.0	13.5	16.5	1.0	18.0	ns
		5.0	1.0	11.0	13.0	1.0	14.0	
Propagation delay C <sub>0</sub> to C <sub>4</sub>	t <sub>PLH</sub>	3.3	1.0	9.5	12.5	1.0	15.5	ns
		5.0	1.0	7.5	9.5	1.0	10.5	
Propagation delay C <sub>0</sub> to C <sub>4</sub>	t <sub>PHL</sub>	3.3	1.0	10.0	13.0	1.0	14.0	ns
		5.0	1.0	8.0	10.0	1.0	11.0	
Propagation delay A <sub>n</sub> or B <sub>n</sub> to C <sub>4</sub>	t <sub>PLH</sub>	3.3	1.0	11.5	14.5	1.0	16.0	ns
		5.0	1.0	9.5	11.5	1.0	12.5	
Propagation delay A <sub>n</sub> or B <sub>n</sub> to C <sub>4</sub>	t <sub>PHL</sub>	3.3	1.0	12.0	15.0	1.0	16.5	ns
		5.0	1.0	10.0	12.0	1.0	13.0	

Note: 1. Voltage Range 3.3 is 3.3 V ± 0.3 V  
Voltage Range 5.0 is 5.0 V ± 0.5 V

## AC Characteristics: HD74ACT283

Item	Symbol	V <sub>CC</sub> (V)*1	Ta = +25°C C <sub>L</sub> = 50 pF			Ta = -40°C to +85°C C <sub>L</sub> = 50 pF		Unit
			Min	Typ	Max	Min	Max	
Propagation delay C <sub>0</sub> to S <sub>n</sub>	t <sub>PLH</sub>	5.0	1.0	11.5	13.5	1.0	14.5	ns
Propagation delay C <sub>0</sub> to S <sub>n</sub>	t <sub>PHL</sub>	5.0	1.0	10.0	12.0	1.0	13.0	ns
Propagation delay A <sub>n</sub> or B <sub>n</sub> to S <sub>n</sub>	t <sub>PLH</sub>	5.0	1.0	13.0	15.0	1.0	16.5	ns
Propagation delay A <sub>n</sub> or B <sub>n</sub> to S <sub>n</sub>	t <sub>PHL</sub>	5.0	1.0	12.0	14.0	1.0	15.5	ns
Propagation delay C <sub>0</sub> to C <sub>4</sub>	t <sub>PLH</sub>	5.0	1.0	9.0	11.0	1.0	12.0	ns
Propagation delay C <sub>0</sub> to C <sub>4</sub>	t <sub>PHL</sub>	5.0	1.0	10.0	12.0	1.0	13.0	ns
Propagation delay A <sub>n</sub> or B <sub>n</sub> to C <sub>4</sub>	t <sub>PLH</sub>	5.0	1.0	11.0	13.0	1.0	14.0	ns
Propagation delay A <sub>n</sub> or B <sub>n</sub> to C <sub>4</sub>	t <sub>PHL</sub>	5.0	1.0	11.5	13.5	1.0	14.5	ns

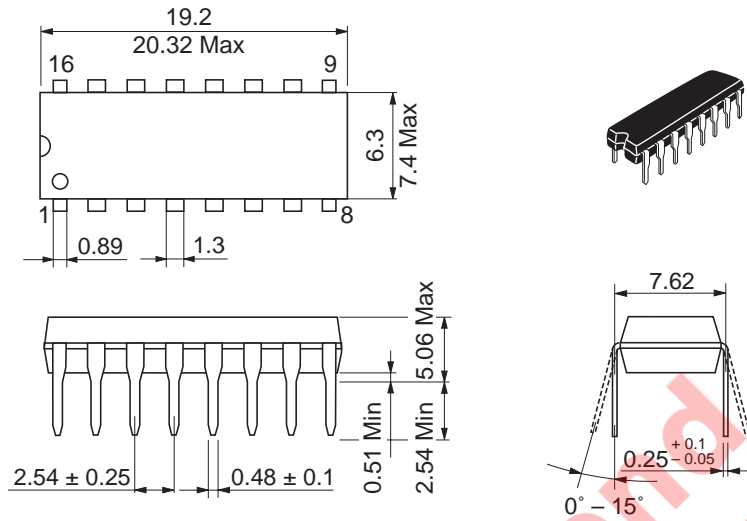
Note: 1. Voltage Range 5.0 is 5.0 V ± 0.5 V

## Capacitance

Item	Symbol	Typ	Unit	Condition
Input capacitance	C <sub>IN</sub>	4.5	pF	V <sub>CC</sub> = 5.5 V
Power dissipation capacitance	C <sub>PD</sub>	60.0	pF	V <sub>CC</sub> = 5.0 V

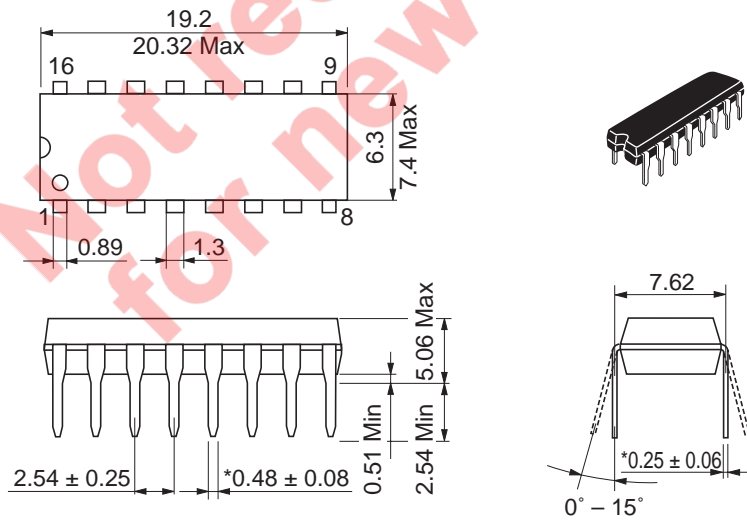
Package Dimensions

As of January, 2003  
Unit: mm



Package Code	DP-16E
JEDEC	Conforms
JEITA	Conforms
Mass (reference value)	1.05 g

Unit: mm



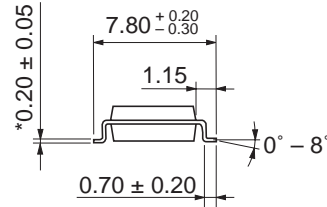
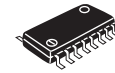
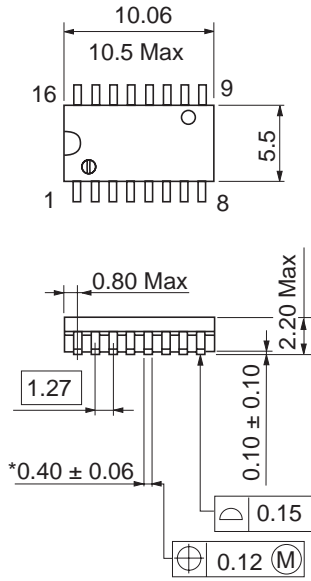
\*Ni/Pd/AU Plating

Package Code	DP-16FV
JEDEC	Conforms
JEITA	Conforms
Mass (reference value)	1.05 g



As of January, 2003

Unit: mm

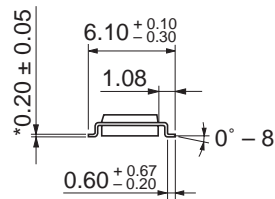
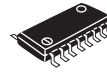
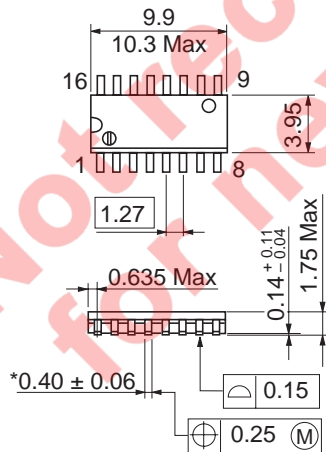


\*Ni/Pd/Au plating

Package Code	FP-16DAV
JEDEC	—
JEITA	Conforms
Mass (reference value)	0.24 g

As of January, 2003

Unit: mm



\*Ni/Pd/Au plating

Package Code	FP-16DNV
JEDEC	Conforms
JEITA	Conforms
Mass (reference value)	0.15 g

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