

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).

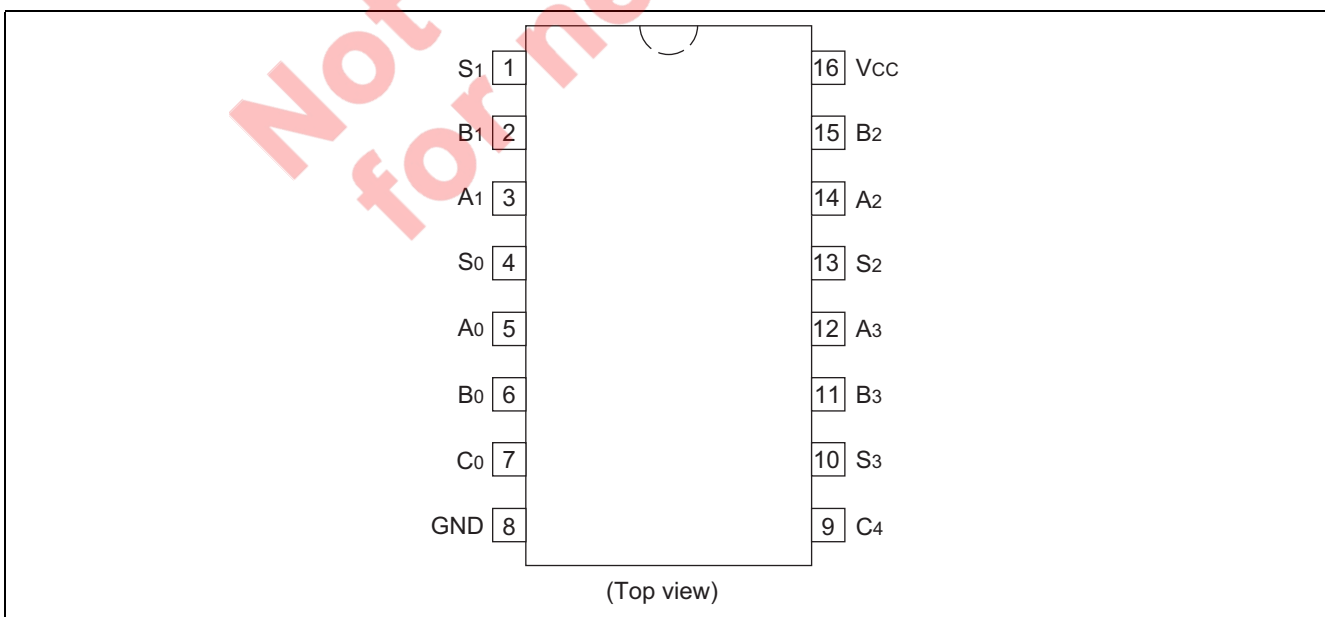
Features

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

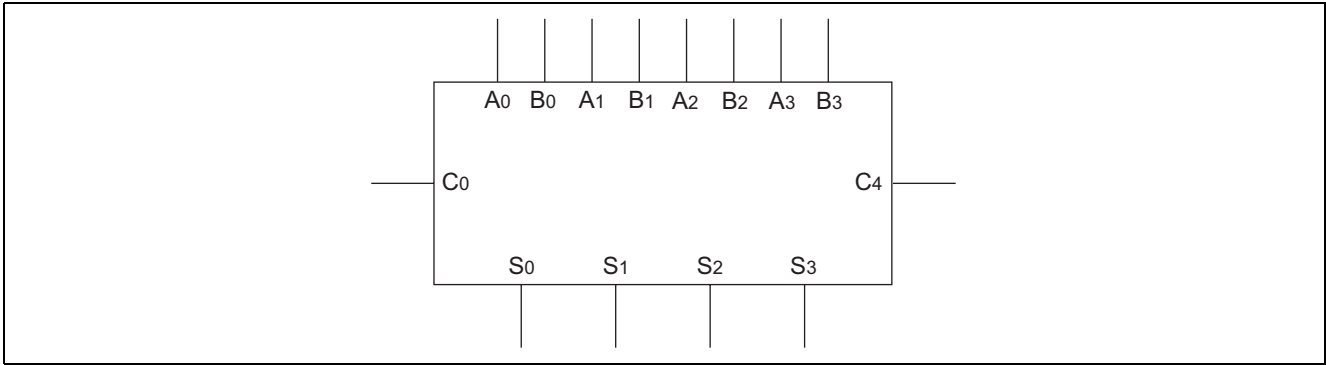
Part Name	Package Type	Package Code	Package Abbreviation	Taping Abbreviation (Quantity)
HD74AC283AP	DIP-16 pin	DP-16E, -16FV	P	—
HD74AC283AFPEL	SOP-16 pin (JEITA)	FP-16DAV	FP	EL (2,000 pcs/reel)
HD74AC283ARPEL	SOP-16 pin (JEDEC)	FP-16DNV	RP	EL (2,500 pcs/reel)
HD74AC283TELL	TSSOP-16 pin	TTP-16DAV	T	ELL(2,000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

- A₀ – A₃ A Operand Inputs
- B₀ – B₃ B Operand Inputs
- C₀ Carry Input
- S₀ – S₃ Sum Outputs
- C₄ Carry Output

Functional Description

The HD74AC283/HD74ACT283 adds two 4-bit binary words (A plus B) plus the incoming Carry (C₀). The binary sum appears on the Sum (S₀ – S₃) and outgoing carry (C₄) 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 C₀, A₀, B₀ 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 C₀ 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 (A₃, B₃) Low makes S₃ 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 (A₂, B₂, S₂) is used merely as a means of getting a carry (C₁₀) signal into the fourth stage (via A₂ and B₂) and bringing out the carry from the second stage on S₂. Note that as long as A₂ and B₂ are the same, whether High or Low, they do not influence S₂. Similarly, when A₂ and B₂ 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 S₀, S₁ and S₂ present a binary number equal to the number of inputs I₁ – I₅ that are true. Figure e shows one method of implementing a 5-input majority gate. When three or more of the inputs I₁ – I₅ are true, the output M₅ is true.

Fig. a Active HIGH versus Active LOW Interpretation

	C ₀	A ₀	A ₁	A ₂	A ₃	B ₀	B ₁	B ₂	B ₃	S ₀	S ₁	S ₂	S ₃	C ₄
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

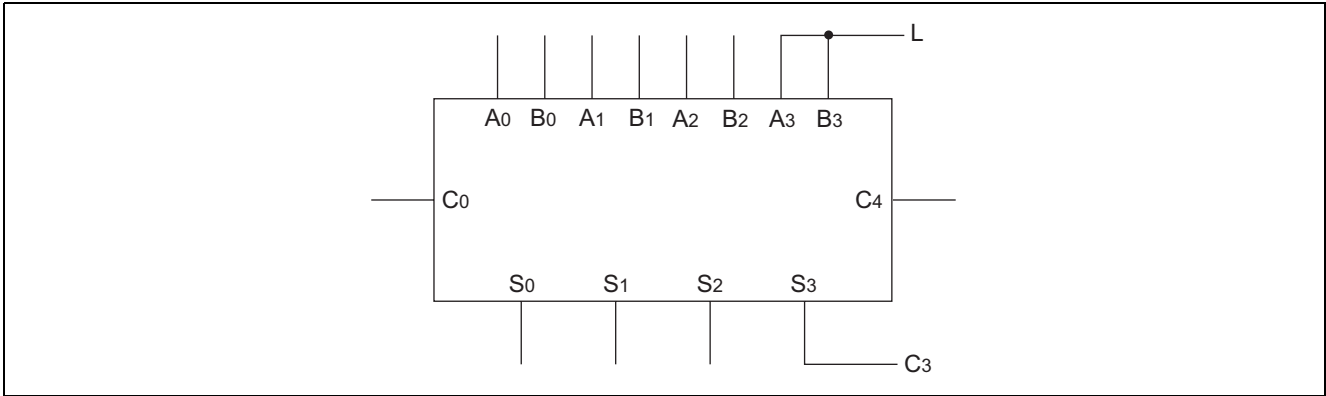


Fig. b 3-bit Adder

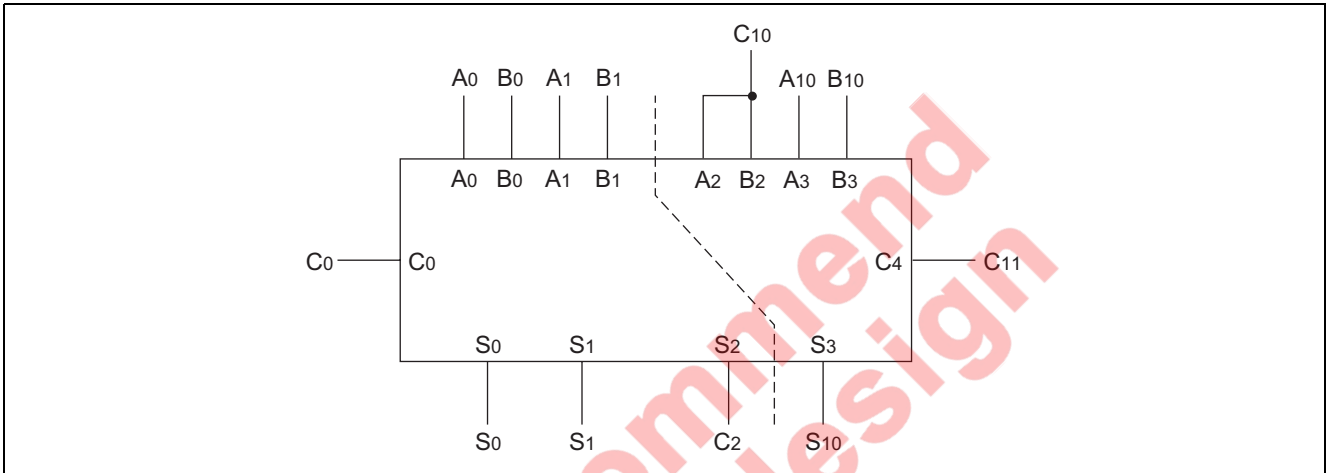


Fig. c 2-bit and 1-bit adders

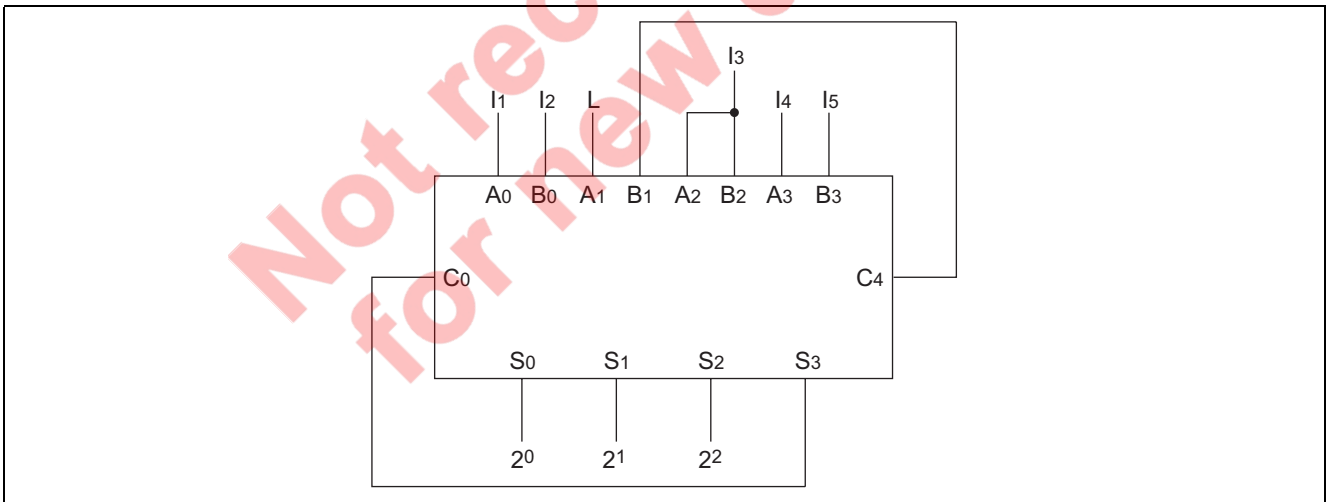


Fig. d 5-Input Encoder

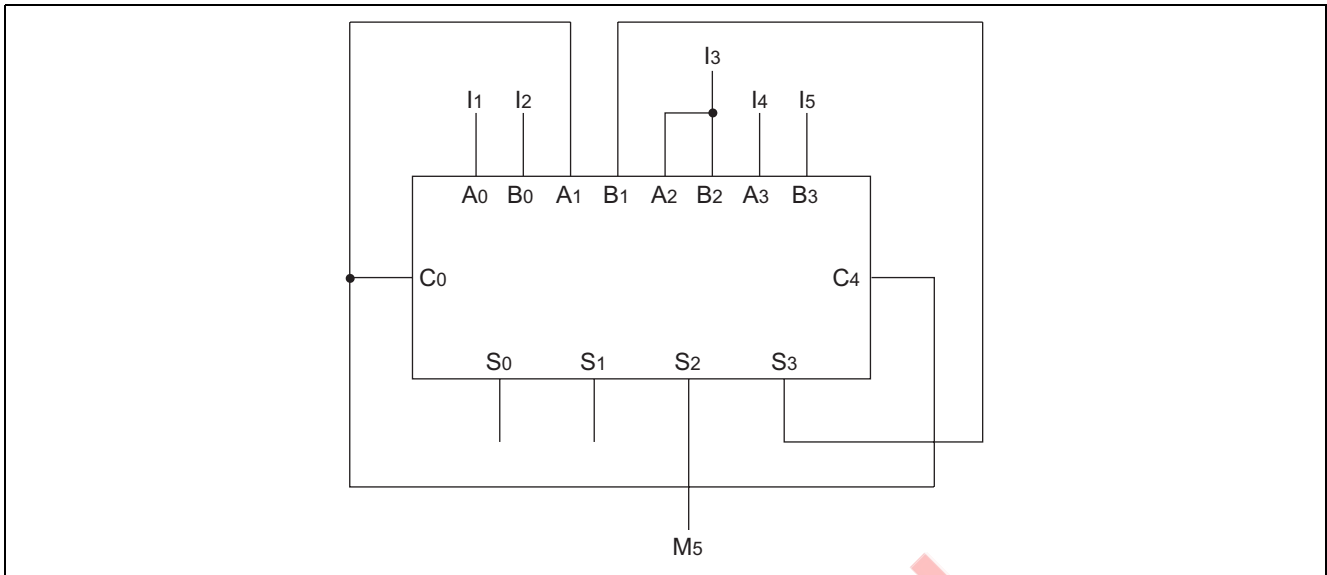
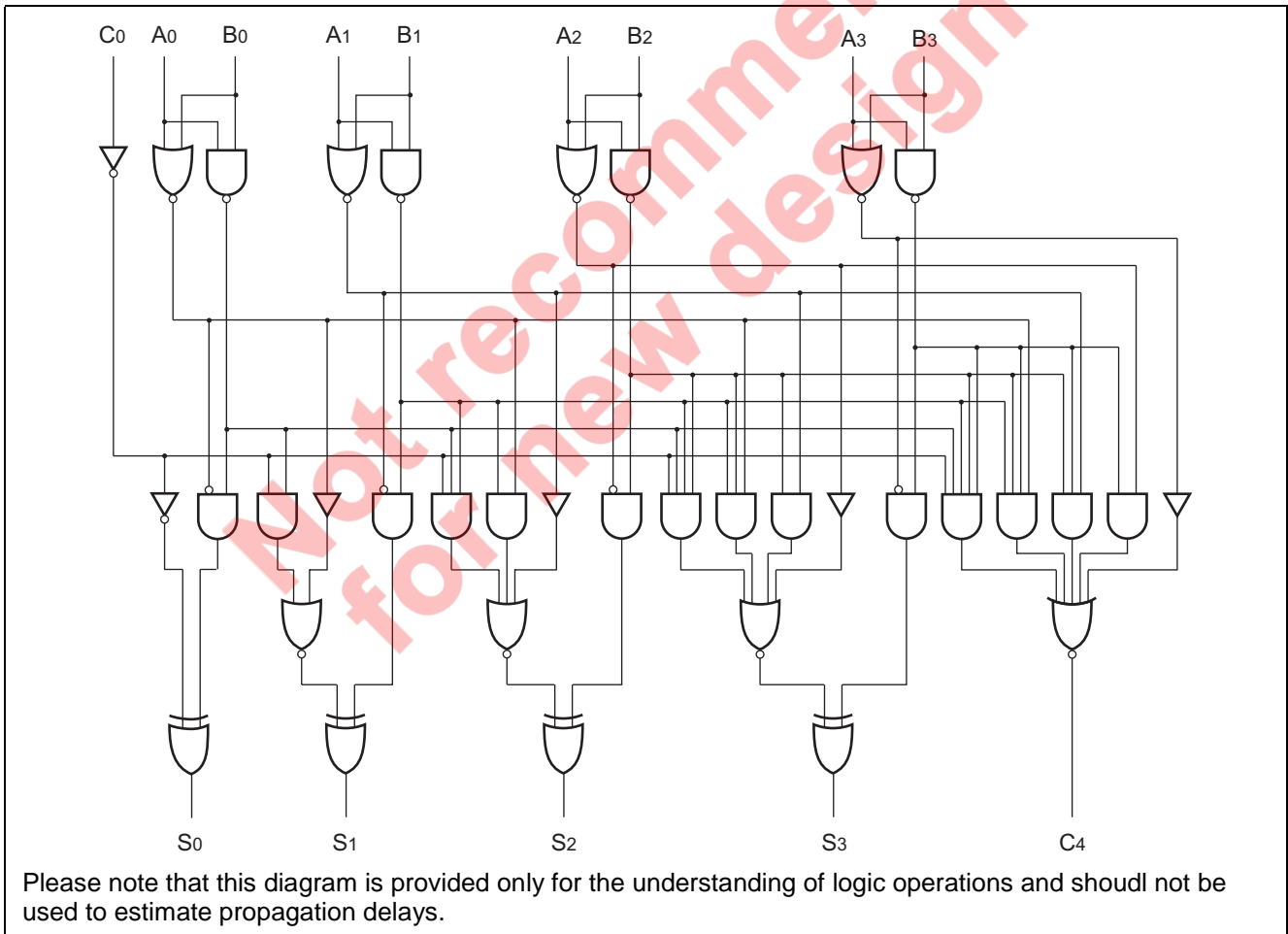


Fig. e 5-Input Majority Gate

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	± 50	mA	
DC V_{CC} or ground current per output pin	I_{CC}, I_{GND}	± 50	mA	
Storage temperature	T_{stg}	-65 to +150	°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	°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	Vcc (V)	$T_a = 25^\circ C$			$T_a = -40 \text{ to } +85^\circ C$		Unit	Condition			
			min.	typ.	max.	min.	max.					
Input Voltage	V_{IH}	3.0	2.1	1.5	—	2.1	—	V	$V_{OUT} = 0.1 V \text{ or } V_{CC} - 0.1 V$			
		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	$V_{OUT} = 0.1 V \text{ or } V_{CC} - 0.1 V$	
		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	$V_{IN} = V_{IL} \text{ or } V_{IH}$ $I_{OUT} = -50 \mu A$			
		4.5	4.4	4.49	—	4.4	—					
		5.5	5.4	5.49	—	5.4	—					
		3.0	2.58	—	—	2.48	—			$V_{IN} = V_{IL} \text{ or } V_{IH}$	$I_{OH} = -12 \text{ mA}$	
		4.5	3.94	—	—	3.80	—				$I_{OH} = -24 \text{ mA}$	
		5.5	4.94	—	—	4.80	—				$I_{OH} = -24 \text{ mA}$	
	V_{OL}	3.0	—	0.002	0.1	—	0.1		V	$V_{IN} = V_{IL} \text{ or } V_{IH}$ $I_{OUT} = 50 \mu A$		
		4.5	—	0.001	0.1	—	0.1					
		5.5	—	0.001	0.1	—	0.1					
		3.0	—	—	0.32	—	0.37				$V_{IN} = V_{IL} \text{ or } V_{IH}$	$I_{OL} = 12 \text{ mA}$
		4.5	—	—	0.32	—	0.37					$I_{OL} = 24 \text{ mA}$
		5.5	—	—	0.32	—	0.37					$I_{OL} = 24 \text{ mA}$
Input leakage current	I_{IN}	5.5	—	—	± 0.1	—	± 1.0	μA	$V_{IN} = V_{CC} \text{ or } GND$			
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	μA	$V_{IN} = V_{CC} \text{ or } ground$			

*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		$V_{OUT} = 0.1 V$ 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		$V_{IN} = V_{IL}$ 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	—	—	± 0.1	—		± 1.0	μA	$V_{IN} = V_{CC}$ 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	μA	$V_{IN} = V_{CC}$ or ground		

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

AC Characteristics: HD74AC283

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

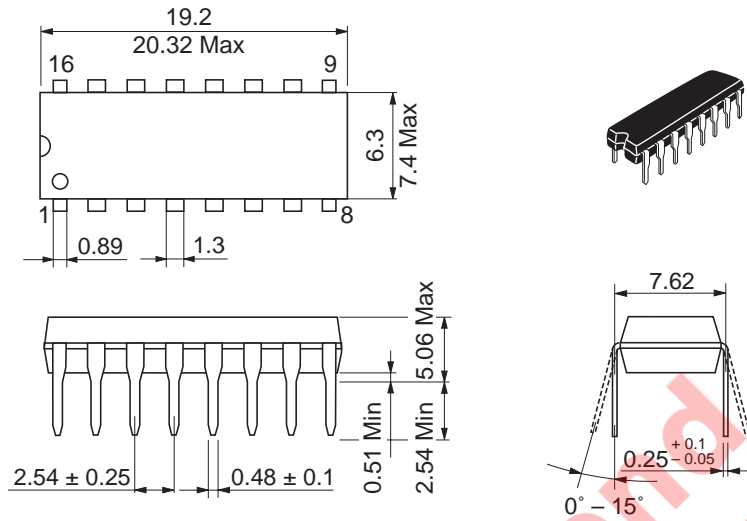
Note: 1. Voltage Range 5.0 is 5.0 V ± 0.5 V

Capacitance

Item	Symbol	Typ	Unit	Condition
Input capacitance	C _{IN}	4.5	pF	V _{CC} = 5.5 V
Power dissipation capacitance	C _{PD}	60.0	pF	V _{CC} = 5.0 V

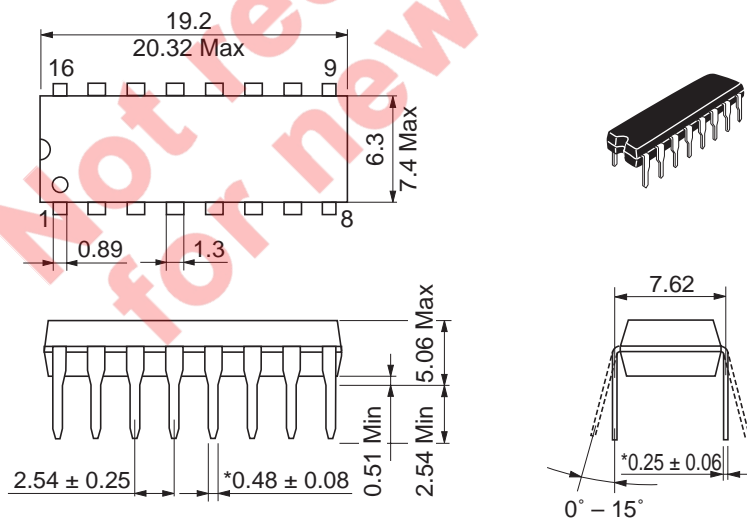
Package Dimensions

As of January, 2003
Unit: mm



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

Unit: mm

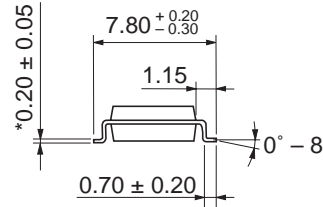
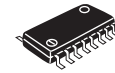
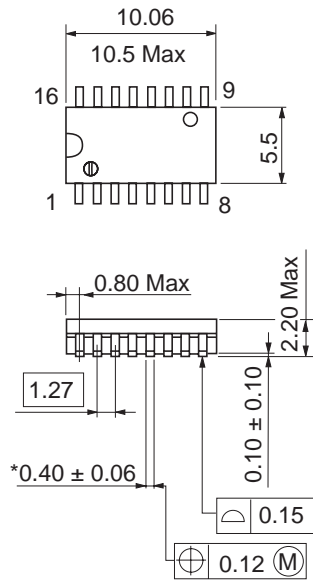


*Ni/Pd/AU Plating

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

As of January, 2003

Unit: mm

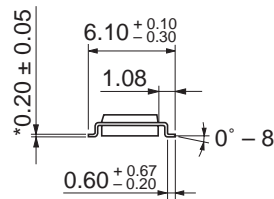
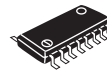
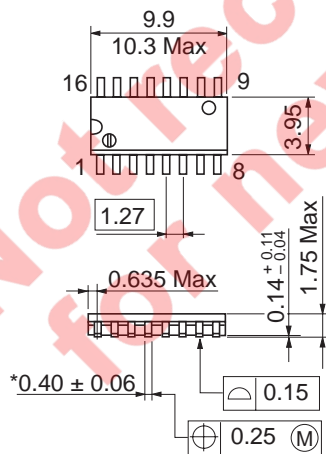


*Ni/Pd/Au plating

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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