Signetics

7483, LS83A
Adders

4-Bit Full Adder
Product Specification

Logic Products

FEATURES

- **High speed 4-bit binary addition**
- **Cascadeable in 4-bit increments**
- **LS83A has fast internal carry lookahead**
- **See '283 for corner power pin version**

DESCRIPTION

The '83 adds two 4-bit binary words (A_n plus B_n) plus the incoming carry. The binary sum appears on the Sum outputs ($\Sigma_1 - \Sigma_4$) and the outgoing carry (C_{OUT}) according to the equation:

$$C_{IN} + (A_1 + B_1) + 2(A_2 + B_2) + 4(A_3 + B_3) + 8(A_4 + B_4) = \Sigma_1 + 2\Sigma_2 + 4\Sigma_3 + 8\Sigma_4 + 16C_{OUT}$$

Where (+) = plus.

Due to the symmetry of the binary add function, the '83 can be used with either all active-HIGH operands (positive logic) or with all active-LOW operands (negative logic). See Function Table. With active-HIGH inputs, C_{IN} cannot be left open; it must be held LOW when no "carry in" is intended. Interchanging inputs of equal weight does not affect the operation, thus C_{IN}, A_1, B_1, can arbitrarily be assigned to pins 10, 11, 13, etc.

TYPE	TYPICAL ADD TIMES (TWO 8-BIT WORDS)	TYPICAL SUPPLY CURRENT (TOTAL)
7483	23ns	66mA
74LS83A	25ns	19mA

ORDERING CODE

PACKAGES	COMMERCIAL RANGE V_{CC} = 5V ±5%; T_A = 0°C to +70°C
Plastic DIP	N7483N, N74LS83AN
Plastic SO	N74LS83AD

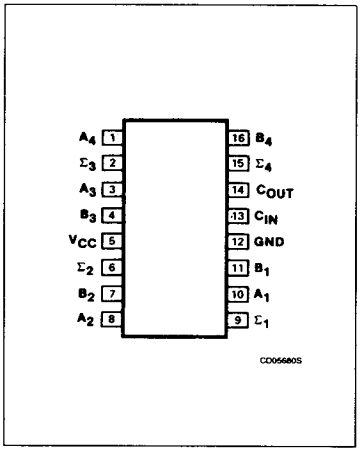
NOTE:
For information regarding devices processed to Military Specifications, see the Signetics Military Products Data Manual.

INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

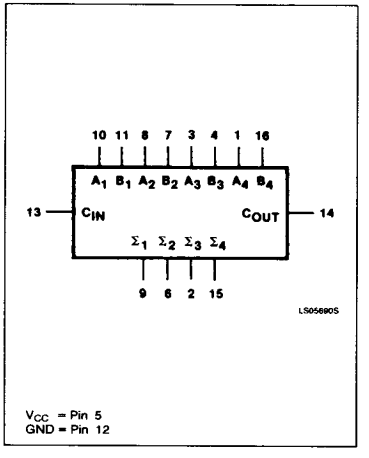
PINS	DESCRIPTION	74	74LS
A_1, B_1, A_3, B_3, C_{IN}	Inputs	2ul	
A_2, B_2, A_4, B_4	Inputs	1ul	
A, B	Inputs		2LSul
C_{IN}	Input		1LSul
Sum	Outputs	10ul	10LSul
Carry	Output	5ul	10LSul

NOTE:
Where a 74 unit load (ul) is understood to be 40μA I_{IH} and −1.6mA I_{IL}, and a 74LS unit load (LSul) is 20μA I_{IH} and −0.4mA I_{IL}.

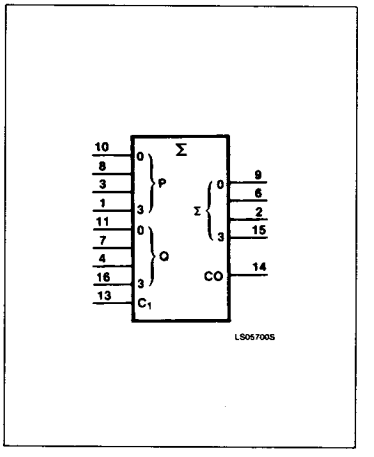
PIN CONFIGURATION



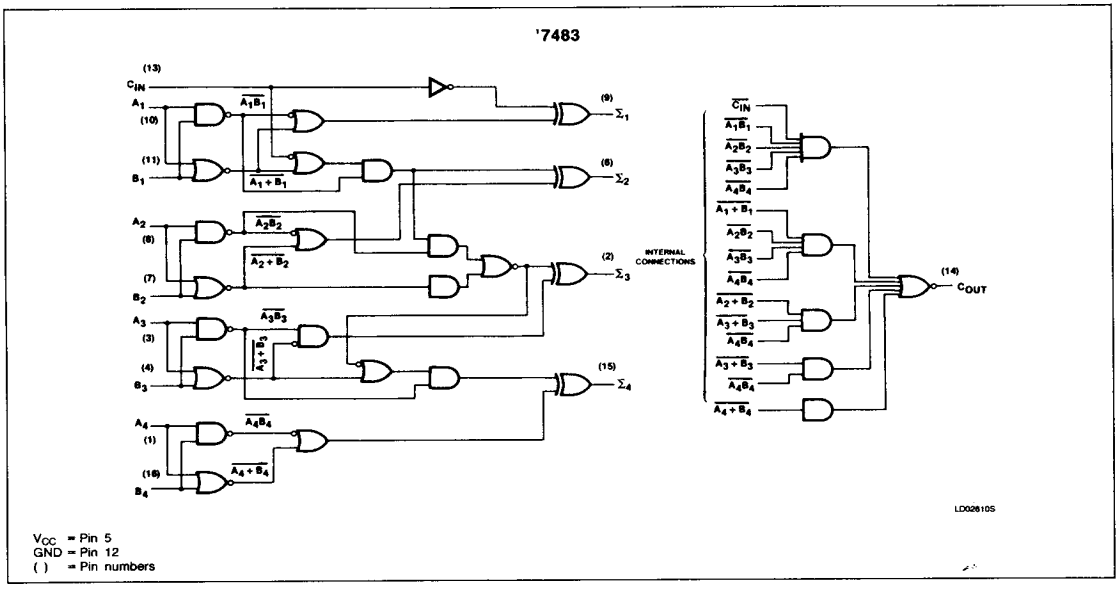
LOGIC SYMBOL



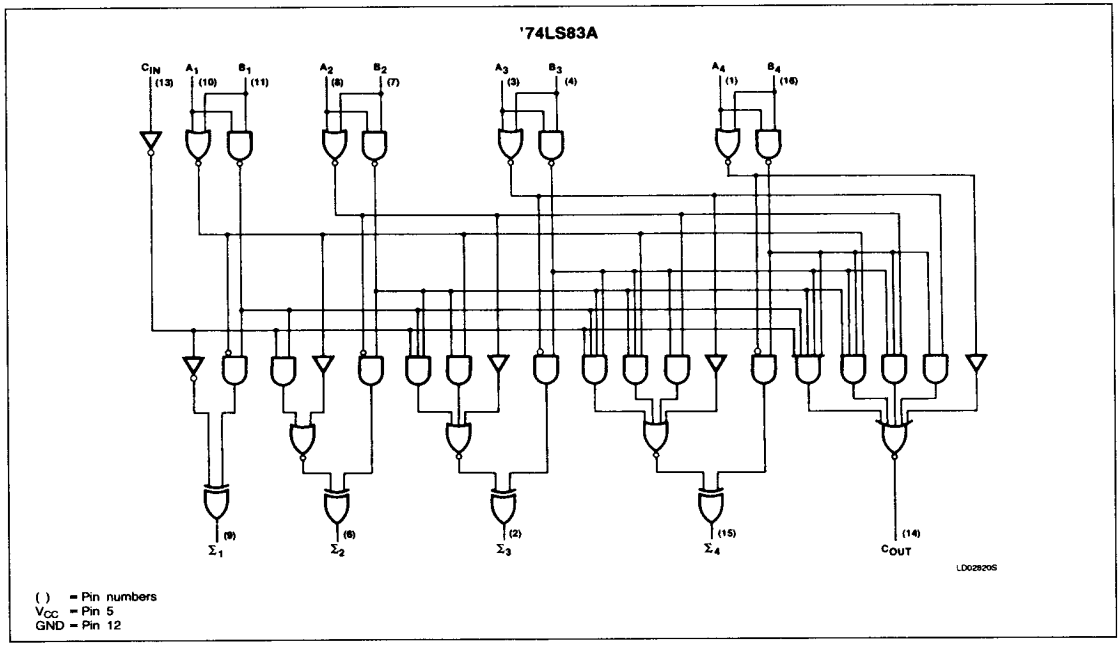
LOGIC SYMBOL (IEEE/IEC)



LOGIC DIAGRAM



LOGIC DIAGRAM



FUNCTION TABLE

PINS	C_{IN}	A_1	A_2	A_3	A_4	B_1	B_2	B_3	B_4	Σ_1	Σ_2	Σ_3	Σ_4	C_{OUT}
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

(10 + 9 = 19)
(carry + 5 + 6 = 12)

ABSOLUTE MAXIMUM RATINGS (Over operating free-air temperature range unless otherwise noted.)

PARAMETER		74	74LS	UNIT
V_{CC}	Supply voltage	7.0	7.0	V
V_{IN}	Input voltage	−0.5 to +5.5	−0.5 to +7.0	V
I_{IN}	Input current	−30 to +5	−30 to +1	mA
V_{OUT}	Voltage applied to output in HIGH output state	−0.5 to +V_{CC}	−0.5 to +V_{CC}	V
T_A	Operating free-air temperature range	0 to 70		°C

RECOMMENDED OPERATING CONDITIONS

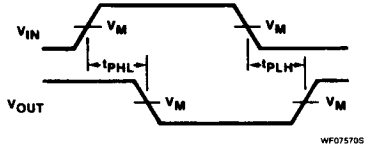
PARAMETER			74			74LS			UNIT
			Min	Nom	Max	Min	Nom	Max	
V_{CC}	Supply voltage		4.75	5.0	5.25	4.75	5.0	5.25	V
V_{IH}	HIGH-level input voltage		2.0			2.0			V
V_{IL}	LOW-level input voltage				+0.8			+0.8	V
I_{IK}	Input clamp current				−12			−18	mA
I_{OH}	HIGH-level output current	Sum			−800			−400	μA
		Carry			−400			−400	μA
I_{OL}	LOW-level output current	Sum			16			8	mA
		Carry			8			8	mA
T_A	Operating free-air temperature		0		70	0		70	°C

DC ELECTRICAL CHARACTERISTICS (Over recommended operating free-air temperature range unless otherwise noted.)

PARAMETER	TEST CONDITIONS[1]			7483			74LS83A			UNIT
				Min	Typ[2]	Max	Min	Typ[2]	Max	
V_{OH} HIGH-level output voltage	V_{CC} = MIN, V_{IH} = MIN, V_{IL} = MAX, I_{OH} = MAX			2.4	3.4		2.7	3.4		V
V_{OL} LOW-level output voltage	V_{CC} = MIN, V_{IH} = MIN, V_{IL} = MAX	I_{OL} = MAX			0.2	0.4		0.35	0.5	V
		I_{OL} = 4mA (74LS)						0.25	0.4	V
V_{IK} Input clamp voltage	V_{CC} = MIN, I_I = I_{IK}					−1.5			−1.5	V
I_I Input current at maximum input voltage	V_{CC} = MAX	V_I = 5.5V				1.0				mA
		V_I = 7.0V	A, B inputs						0.2	mA
			C_{IN} input						0.1	mA
I_{IH} HIGH-level input current	V_{CC} = MAX	V_I = 2.4V	A_1, B_1, A_3, B_3, C_{IN}			80				μA
			A_2, B_2, A_4, B_4			40				μA
		V_I = 2.7V	A, B inputs						40	μA
			C_{IN} input						20	μA
I_{IL} LOW-level input current	V_{CC} = MAX, V_I = 0.4V	A_1, B_1, A_3, B_3, C_{IN}				−3.2				mA
		A_2, B_2, A_4, B_4				−1.6				mA
		A, B inputs							−0.8	mA
		C_{IN} input							−0.4	mA
I_{OS} Short-circuit output current[3]	V_{CC} = MAX	Sum outputs		−18		−55	−20		−100	mA
		C_{OUT} output		−18		−70	−20		−100	mA
I_{CC} Supply current (total)	V_{CC} = MAX, outputs open	All inputs at 4.5V			66	110		19	34	mA
		All inputs grounded						22	39	mA
		All B inputs low, other inputs at 4.5V						19	34	mA

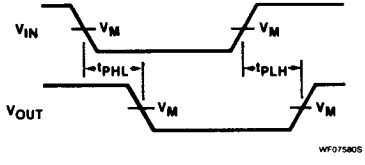
NOTES:
1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at V_{CC} = 5V, T_A = 25°C.
3. I_{OS} is tested with V_{OUT} = +0.5V and V_{CC} = V_{CC} MAX + 0.5V. Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.

AC WAVEFORMS



V_M = 1.3V for 74LS; V_M = 1.5V for all other TTL families.

Waveform 1. Waveform For Inverting Outputs



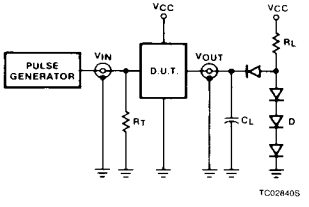
V_M = 1.3V for 74LS; V_M = 1.5V for all other TTL families.

Waveform 2. Waveform For Non-Inverting Outputs

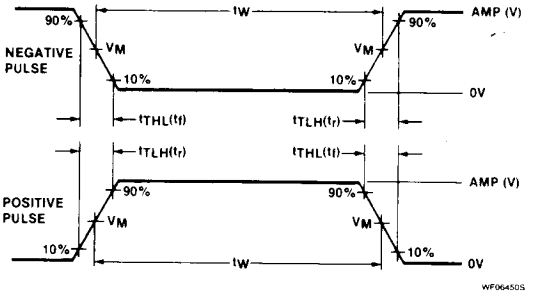
AC ELECTRICAL CHARACTERISTICS $T_A = 25°C$, $V_{CC} = 5.0V$

PARAMETER		TEST CONDITIONS	74		74LS		UNIT
			$C_L = 50pF$, $R_L = 400\Omega$		$C_L = 15pF$, $R_L = 2k\Omega$		
			Min	Max	Min	Max	
t_{PLH} t_{PHL}	Propagation delay C_{IN} to Σ_1	Waveforms 1 & 2		34 34		24 24	ns
t_{PLH} t_{PHL}	Propagation delay C_{IN} to Σ_2	Waveforms 1 & 2		35 35		24 24	ns
t_{PLH} t_{PHL}	Propagation delay C_{IN} to Σ_3	Waveforms 1 & 2		50 40		24 24	ns
t_{PLH} t_{PHL}	Propagation delay C_{IN} to Σ_4	Waveforms 1 & 2		50 50		24 24	ns
t_{PLH} t_{PHL}	Propagation delay A_i or B_i to Σ_i	Waveforms 1 & 2		40 35		24 24	ns
t_{PLH} t_{PHL}	Propagation delay C_{IN} to C_{OUT}	Waveform 2 $R_L = 780\Omega$ for 7483		20 20		17 22	ns
t_{PLH} t_{PHL}	Propagation delay A_i or B_i to C_{OUT}	Waveforms 1 & 2 $R_L = 780\Omega$ for 7483		22 22		17 17	ns

TEST CIRCUITS AND WAVEFORMS



Test Circuit For 74 Totem-Pole Outputs



$V_M = 1.3V$ for 74LS; $V_M = 1.5V$ for all other TTL families.

Input Pulse Definition

FAMILY	INPUT PULSE REQUIREMENTS				
	Amplitude	Rep. Rate	Pulse Width	t_{TLH}	t_{THL}
74	3.0V	1MHz	500ns	7ns	7ns
74LS	3.0V	1MHz	500ns	15ns	6ns
74S	3.0V	1MHz	500ns	2.5ns	2.5ns

DEFINITIONS

R_L = Load resistor to V_{CC}; see AC CHARACTERISTICS for value.
C_L = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.
R_T = Termination resistance should be equal to Z_{OUT} of Pulse Generators.
D = Diodes are 1N916, 1N3064, or equivalent.
t_{TLH}, t_{THL} Values should be less than or equal to the table entries.