M74LS283P

4-BIT BINARY FULL ADDER WITH FAST CARRY

DESCRIPTION

The M74LS283P is a semiconductor integrated circuit containing a 4-bit full adder function using the look-ahead carry method of operation.

FEATURES

- Full-carry look-ahead across the four bits
- Systems achieve partial look-ahead performance with the economy of ripple carry
- Wide operating temperature range (Ta = −20 ~ +75°C)

APPLICATION

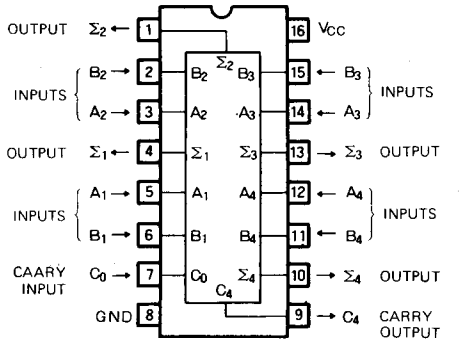
General purpose, for use in industrial and consumer equipment

FUNCTIONAL DESCRIPTION

This device functions as a 2-group, 4-bit binary adder with full adder capability. When a 4-bit binary number is applied to input A_1 thru A_4 or B_1 thru B_4 and a carry signal from the previous column is applied to input C_0, the sum output for the respeetive bits will appear at output $\Sigma_1 \sim \Sigma_4$; and carry output to the following column will appear at C_4.

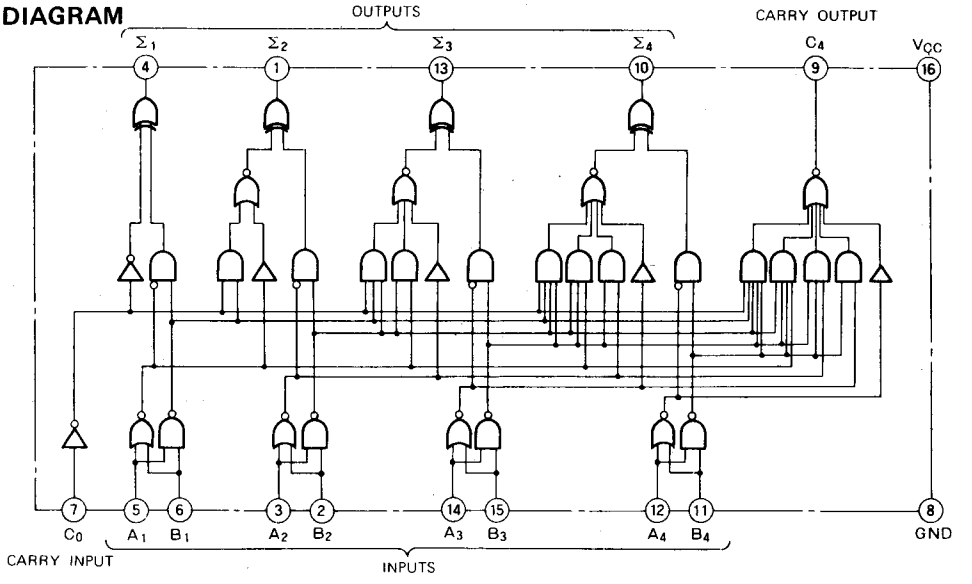
The full adder capability of this device is also complete with full look-ahead carry operations, and its high speed means that a 4-bit carry output is produced at an average rate of 8ns (typical). Thus, when N-stages are configured for parallel addition of an N-number of 4-bit inputs, a carry output can be obtained with a 8Nns delay time. (See the application example provided in the back of this specification sheet.) Also provided is the M74LS83AP with the same functions and electrical characteristics. This device differs only in its pin configuration.

PIN CONFIGURATION (TOP VIEW)



Outline 16 P4

BLOCK DIAGRAM



4-BIT BINARY FULL ADDER WITH FAST CARRY

FUNCTION TABLE (Note 1)

C_{k-1}	A_k	B_k	Σ_k	C_k
L	L	L	L	L
L	H	L	H	L
L	L	H	H	L
L	H	H	L	H
H	L	L	H	L
H	H	L	L	H
H	L	H	L	H
H	H	H	H	H

Note 1. Σ_K and C_K are the sum and carry output calculated in response to input at A_K, B_K, and C_{K-1} (carry input), derived from the following logical equation.

$\Sigma_K = A_K \oplus B_K \oplus C_{K-1}$

$C_K = A_K \cdot B_K + (A_K + B_K) \cdot C_{K-1}$

(Where K = 1~4; $\oplus$ = Exclusive OR; + = OR; · = AND)

ABSOLUTE MAXIMUM RATINGS ($T_a = -20 \sim +75°C$, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		−0.5 ~ +7	V
V_I	Input voltage		−0.5 ~ +15	V
V_O	Output voltage	High-level state	−0.5 ~ V_{CC}	V
Topr	Operating free-air ambient temperature range		−20 ~ +75	°C
Tstg	Storage temperature range		−65 ~ +150	°C

RECOMMENDED OPERATING CONDITIONS ($T_a = -20 \sim +75°C$, unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4.75	5	5.25	V
I_{OH}	High-level output current	$V_{OH} \geq 2.7V$	0		−400	μA
I_{OL}	Low-level output current	$V_{OL} \leq 0.4V$	0		4	mA
		$V_{OL} \leq 0.5V$	0		8	mA

ELECTRICAL CHARACTERISTICS ($T_a = -20 \sim +75°C$, unless otherwise noted)

Symbol	Parameter		Test conditions		Limits			Unit
					Min	Typ *	Max	
V_{IH}	High-level input voltage				2			V
V_{IL}	Low-level input voltage						0.8	V
V_{IC}	Input clamp voltage		V_{CC}=4.75V, I_{IC}=−18mA				−1.5	V
V_{OH}	High-level output voltage		V_{CC}=4.75V, V_I=0.8V V_I=2V, I_{OH}=−400μA		2.7	3.4		V
V_{OL}	Low-level output voltage		V_{CC}=4.75V V_I=0.8V, V_I=2V	I_{OL}=4mA		0.25	0.4	V
				I_{OL}=8mA		0.35	0.5	V
I_{IH}	High-level input current	C_0	V_{CC}=5.25V, V_I=2.7V				20	μA
		$A_1 \sim A_4$, $B_1 \sim B_4$					40	
		C_0	V_{CC}=5.25V, V_I=10V				0.1	mA
		$A_1 \sim A_4$, $B_1 \sim B_4$					0.2	
I_{IL}	Low-level input current	C_0	V_{CC}=5.25V, V_I=0.4V				−0.4	mA
		$A_1 \sim A_4$, $B_1 \sim B_4$					−0.8	
I_{OS}	Short-circuit output current (Note 2)		V_{CC}=5.25V, V_O=0V		−20		−100	mA
I_{CC}	Supply current		V_{CC}=5.25V, V_I=0V			22	39	mA
			V_{CC}=5.25V, V_I=0V, V_I=4.5V (Note 3)			19	34	
			V_{CC}=5.25V, V_I=4.5V			19	34	

* : All typical values are at V_{CC} = 5V, T_a = 25°C.

Note 2. All measurements should be done quickly, and not more than one output should be shorted at a time.

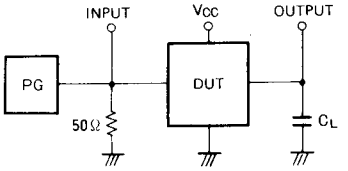
Note 3. I_{CC} is measured with $B_1 \sim B_4$ at 0V and with all other inputs 4.5V.

4-BIT BINARY FULL ADDER WITH FAST CARRY

SWITCHING CHARACTERISTICS (V_{CC}=5V, T_a=25°C, unless otherwise noted)

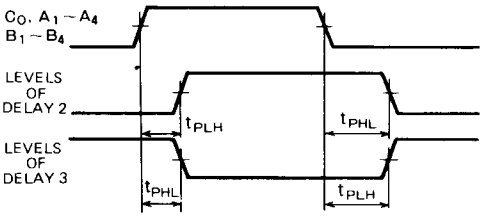
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input C_0 to outputs Σ_1~Σ_4	C_L=15pF (Note 4)		12	24	ns
t_{PHL}				13	24	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from inputs A_1~A_4 or B_1~B_4 to outputs Σ_1~Σ_4			9	24	ns
t_{PHL}				11	24	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from inputs C_0 to output C_4			8	17	ns
t_{PHL}				8	22	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from inputs A_1~A_4 or B_1~B_4 to output C_4			8	17	ns
t_{PHL}				8	17	ns

Note 4. Measurement Circuit



(1) The pulse generator (PG) has the following characteristics: PRR = 1MHz, t_r = 6ns, t_f = 6ns, t_W = 500ns, V_P = $3V_{P-P}$, Z_O = 50Ω.
(2) C_L includes probe and jig capacitance.

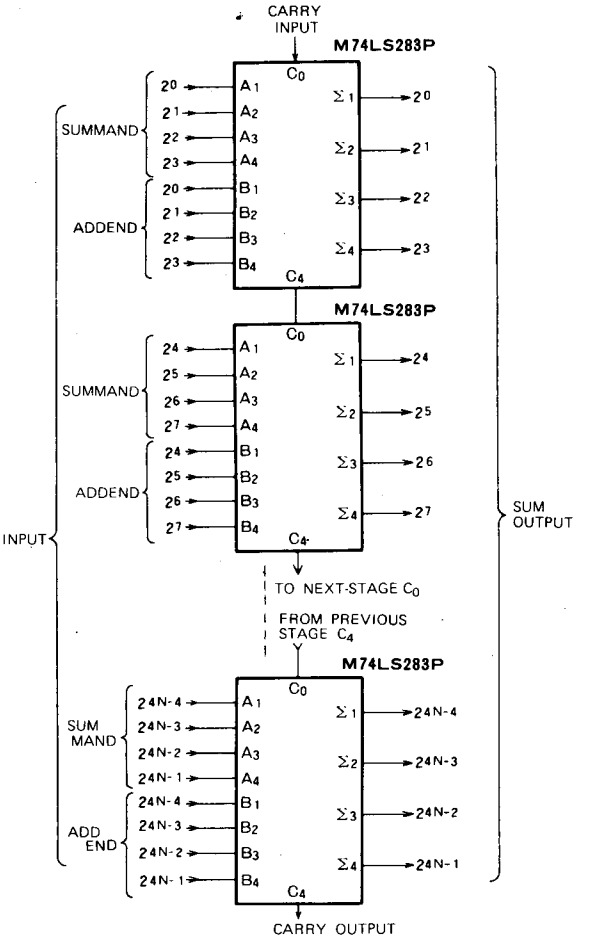
TIMING DIAGRAM (Reference level = 1.3V)



APPLICATION EXAMPLE

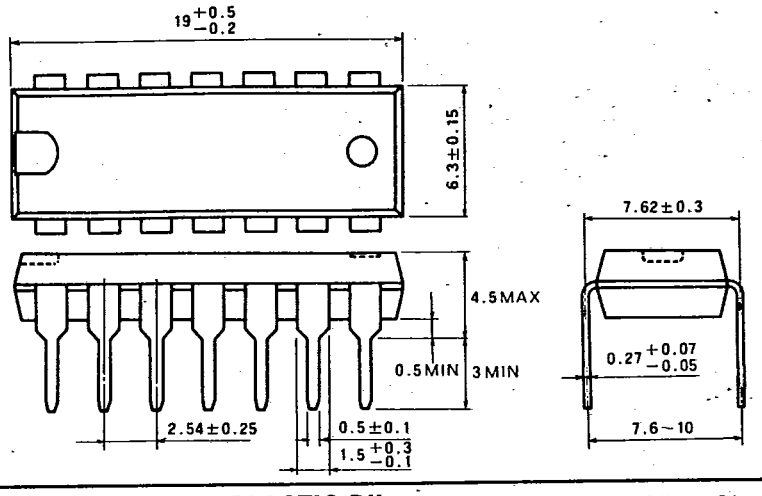
The accompanying diagram shows an N-number of M74LS283P devices connected in parallel for addition of an N-number of 4-bit inputs. Typical delay times for carry output in this circuit configuration are listed below. This figures indicates the suitability of this device for use in a high-speed adder employing the ripple-carry method.

N=1	(4 bits)	10.5ns
N=2	(8 bits)	21ns
N=3	(12 bits)	31.5ns
N=4	(16 bits)	42ns
N=8	(32 bits)	84ns



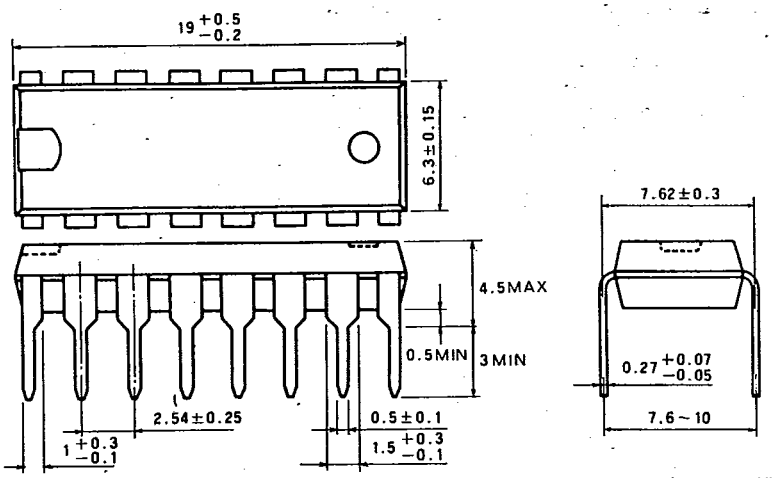
TYPE 14P4 14-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 16P4 16-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 20P4 20-PIN MOLDED PLASTIC DIL

Dimension in mm