M74LS83AP

4-BIT BINARY FULL ADDER WITH FAST CARRY

DESCRIPTION

The M74LS83AP is a semiconductor integrated circuit containing a 4-bit binary look ahead carry type full adder.

FEATURES

- High speed with look-ahead carry addition
- Possible configuration of systems with partial look-ahead carry
- Wide operating temperature range (T_a=−20~+75°C)

APPLICATION

General purpose, for use in industrial and consumer equipment.

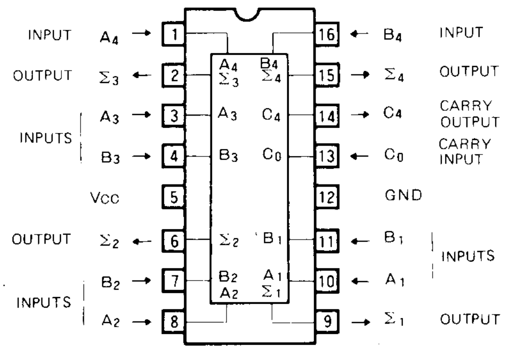
FUNCTIONAL DESCRIPTION

This device performs the addition of two 4-bit binary numbers. When a 4-bit binary number is applied to inputs A_1~A_4 and B_1~B_4 and the carry signal from the previous digit is applied to input C_0, the respective bit sum output and carry outputs for the next upper digit appear in outputs Σ_1~Σ_4 and C_4.

This adder features full internal look ahead across all four bits generating the carry term in 8ns typically. Therefor, the carry output can be obtained in a delay time of 8Nns when N-stages are connected and a 4N-bit parallel adder is configured. (Refer to application example.)

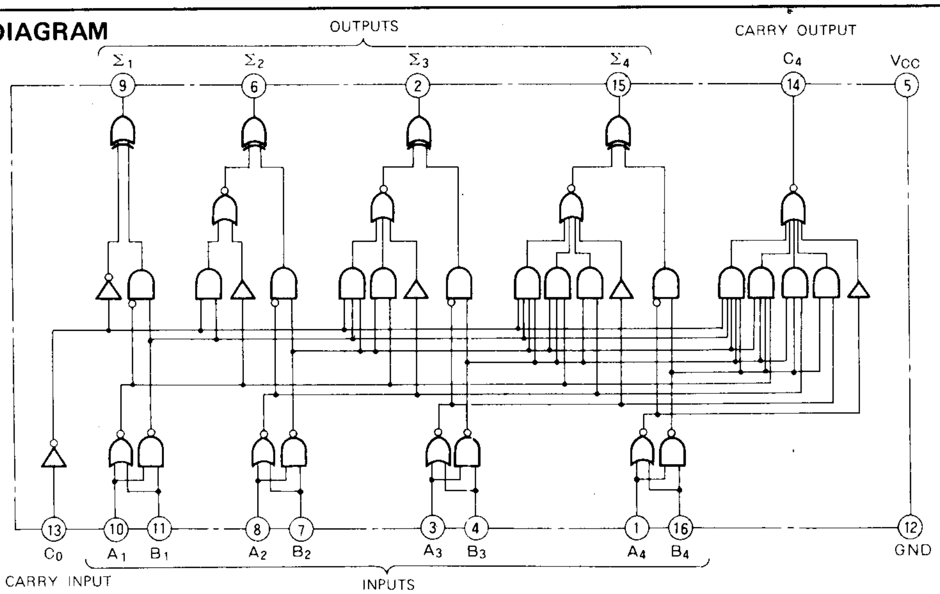
Also available is the M74LS283P with the same functions and electrical characteristics and with a pin 16 V_{CC} and 8 GND configuration.

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 C_k and Σ_k are the carry output and sum output obtained by adding A_k, B_k and C_{k-1} (carry input), and they are expressed in the following logical expression.

$\Sigma_k = A_k \oplus B_k \oplus C_{k-1}$

$C_k = A_k \cdot B_k + (A_k + B_k) \cdot C_{k-1}$

Where $k = 1 \sim 4$

$\oplus$ = Exclusive OR

$+$ = OR

$\cdot$ = AND

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

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

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

Symbol	Parameter		Limits Min	Typ	Max	Unit
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 Min	Typ *	Max	Unit
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		$V_{CC}=4.75V$, $V_I=0.8V$ $V_I=2V$, $I_{OH}=-400\mu A$		2.7	3.4		V
V_{OL}	Low-level output voltage		$V_{CC}=4.75V$	$I_{OL}=4mA$		0.25	0.4	V
			$V_I=0.8V$, $V_I=2V$	$I_{OL}=8mA$		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	mA
			$V_{CC}=5.25V$, $V_I=4.5V$			19	34	mA

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

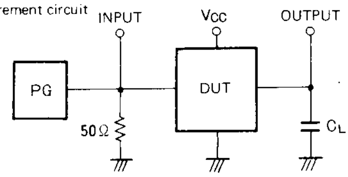
Note 2: All measurements should be done quickly and not more than one output should be shorted at a time.

Note 3: Measurement should be conducted with inputs $B_1 - B_4$ at 0V and the other inputs at 4.5V.

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

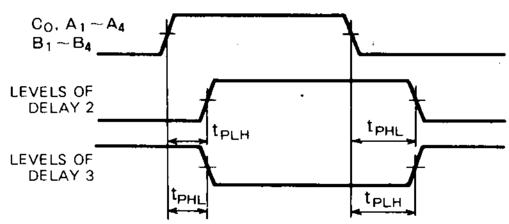
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input C_0 to outputs $\Sigma_1 \sim \Sigma_4$	C_L = 15pF (Note 4)		12	24	ns
t_{PHL}				13	24	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from inputs $A_1 \sim A_4$, $B_1 \sim B_4$ to outputs $\Sigma_1 \sim \Sigma_4$			9	24	ns
t_{PHL}				11	24	ns
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input 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 $A_1 \sim A_4$, $B_1 \sim B_4$ 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=3$V_{P\text{-}P}$, Z_O= 50Ω.
(2) C_L includes probe and jig capacitance

TIMING DIAGRAM (Reference level = 1.3V)

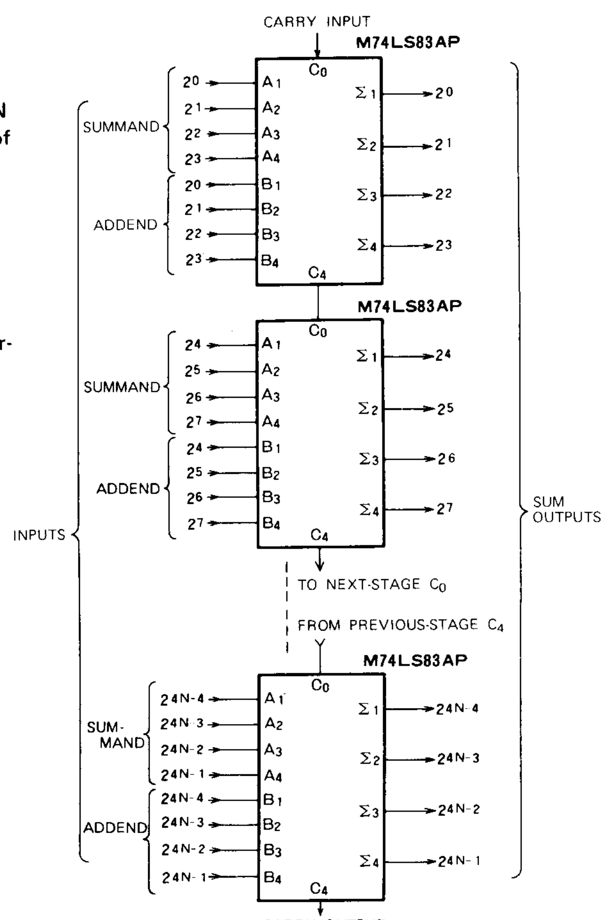


APPLICATION EXAMPLE

Shown on the right is a 4N-bit binary parallel adder using N number of M74LS83AP devices. The typical delay times of the carry output in this circuit are:

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

This allows a high-speed ripple carry adder to be configured.



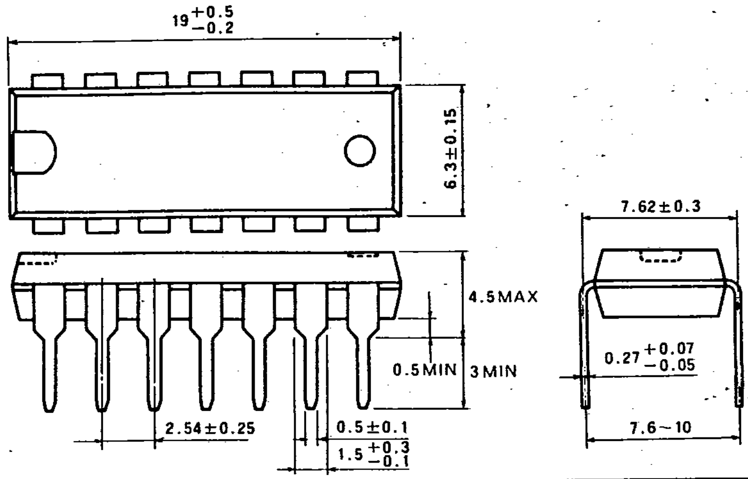
PACKAGE OUTLINES

MITSUBISHI {DGTL LOGIC} 07E D 6249827 0013561 3

T-90-20

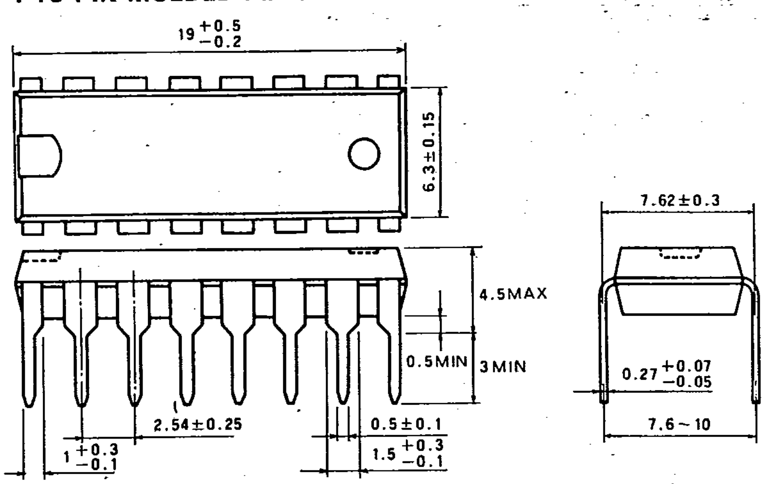
TYPE 14P4 14-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 16P4 16-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 20P4 20-PIN MOLDED PLASTIC DIL

Dimension in mm