

SN5483A, SN54LS83A, SN7483A, SN74LS83A 4-BIT BINARY FULL ADDERS WITH FAST CARRY

MARCH 1974 — REVISED MARCH 1988

- Full-Carry Look-Ahead across the Four Bits
- Systems Achieve Partial Look-Ahead Performance with the Economy of Ripple Carry
- SN54283/SN74283 and SN54LS283/SN74LS283 Are Recommended For New Designs as They Feature Supply Voltage and Ground on Corner Pins to Simplify Board Layout

TYPE	TYPICAL ADD TIMES		TYPICAL POWER DISSIPATION PER 4-BIT ADDER
	TWO 8-BIT WORDS	TWO 16-BIT WORDS	
	'83A	'LS83A	
	23 ns	43 ns	310 mW
	25 ns	45 ns	95 mW

description

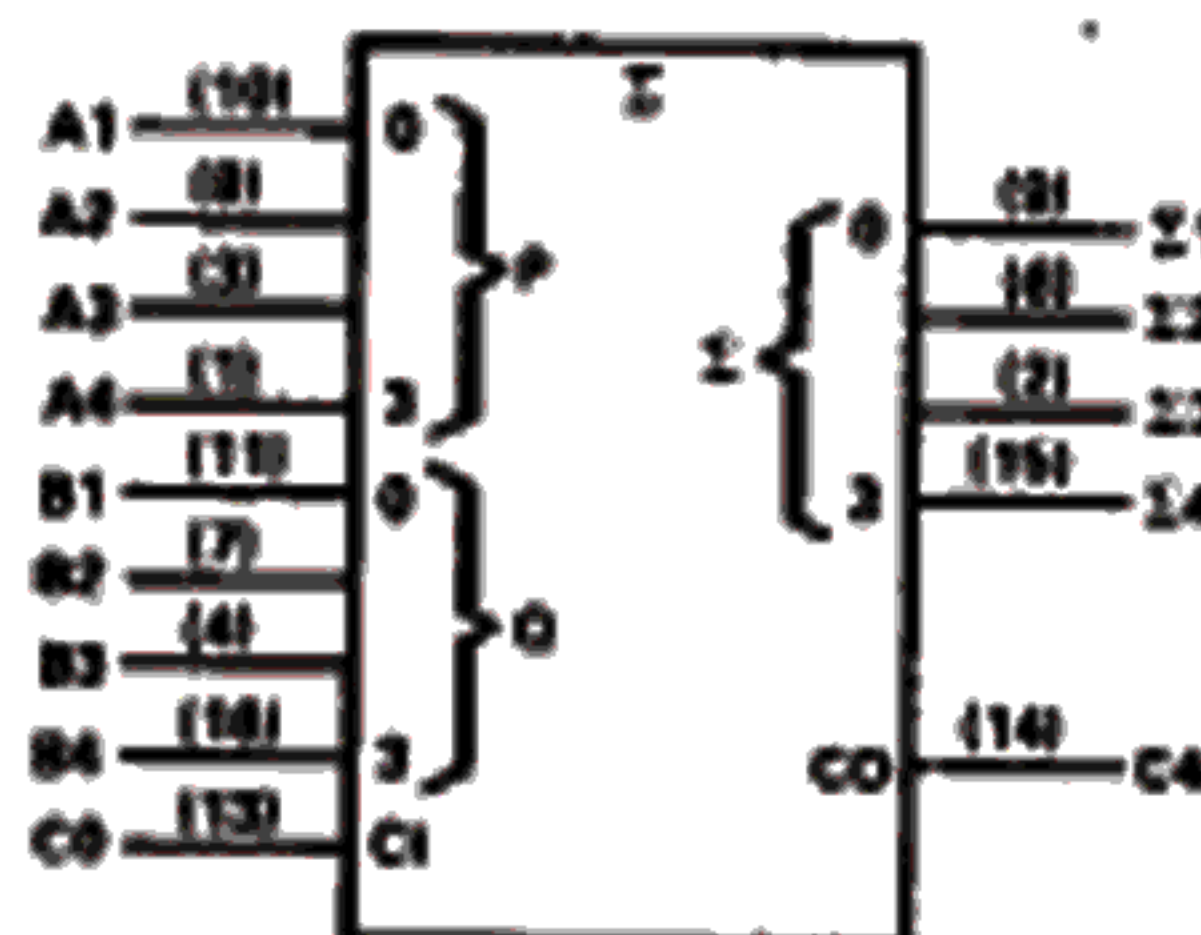
These improved full adders perform the addition of two 4-bit binary numbers. The sum (Σ) outputs are provided for each bit and the resultant carry (C_4) is obtained from the fourth bit. These adders feature full internal look ahead across all four bits generating the carry term in ten nanoseconds typically. This provides the system designer with partial look-ahead performance at the economy and reduced package count of a ripple-carry implementation.

The adder logic, including the carry, is implemented in its true form meaning that the end-around carry can be accomplished without the need for logic or level inversion.

Designed for medium-speed applications, the circuits utilize transistor-transistor logic that is compatible with most other TTL families and other saturated low-level logic families.

Series 54 and 54LS circuits are characterized for operation over the full military temperature range of -55°C to 125°C , and Series 74 and 74LS circuits are characterized for operation from 0°C to 70°C .

logic symbol†



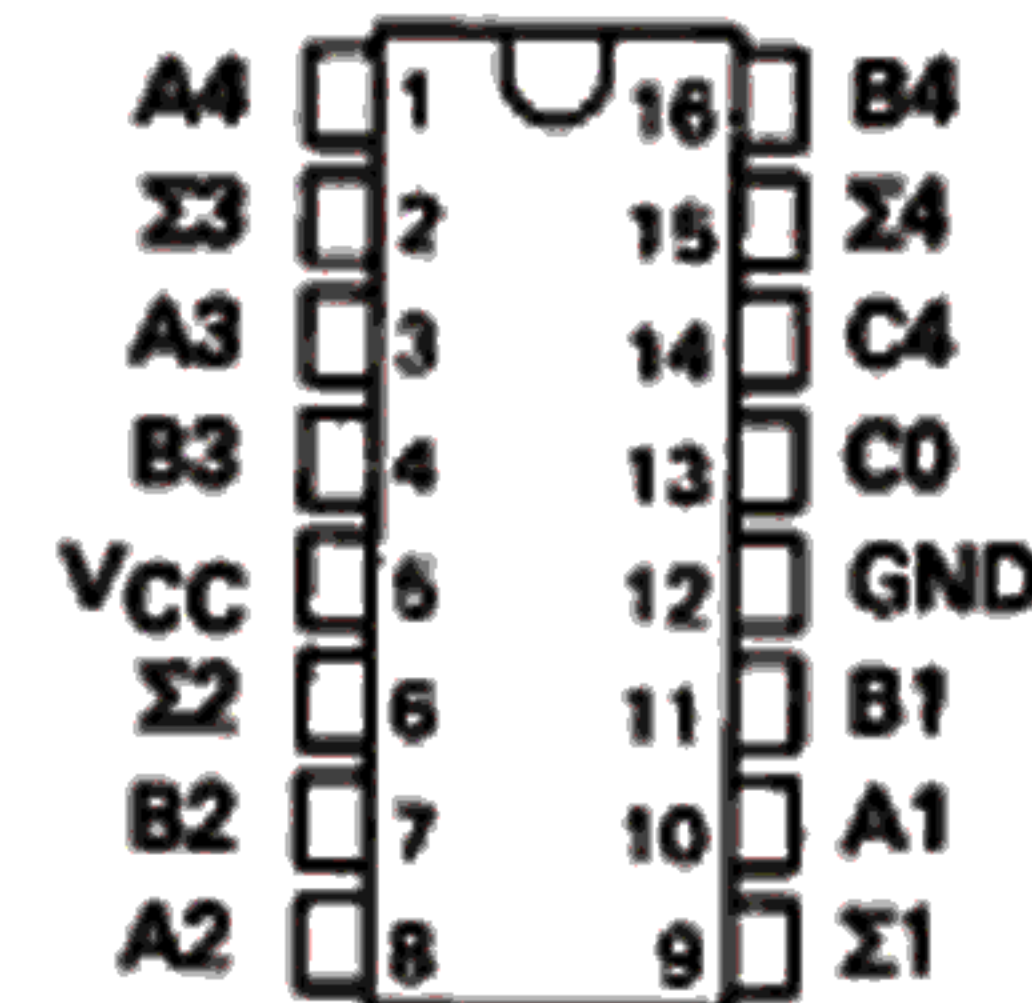
†This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Pin numbers are for D, J, N, and W packages.

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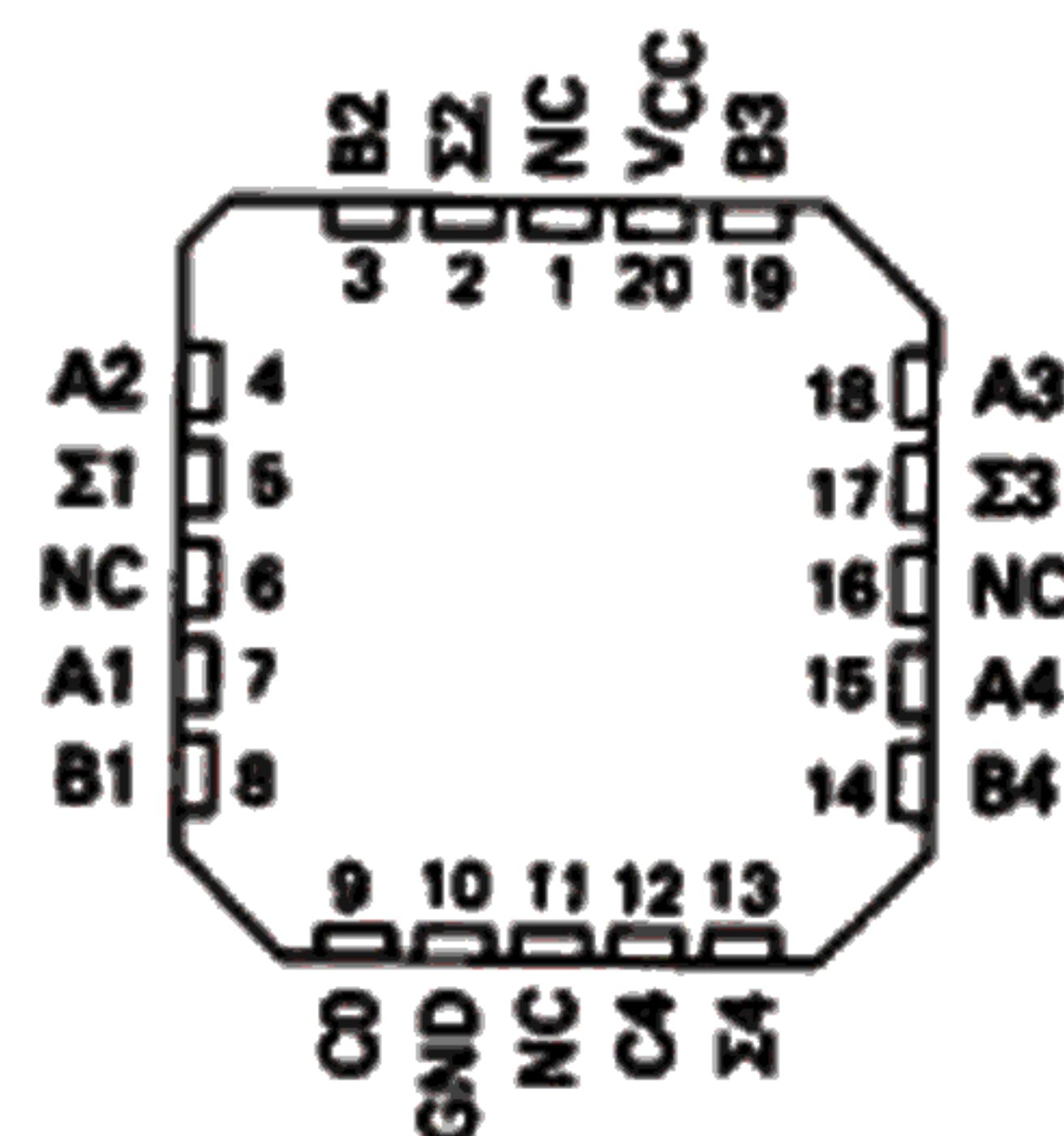
SN5483A, SN54LS83A . . . J OR W PACKAGE
SN7483A . . . N PACKAGE
SN74LS83A . . . D OR N PACKAGE

(TOP VIEW)



SN54LS83A . . . FK PACKAGE

(TOP VIEW)



NC - No internal connection

FUNCTION TABLE

INPUT				OUTPUT					
				WHEN $C_0 = L$			WHEN $C_0 = H$		
A1	B1	A2	B2	Σ_1	Σ_2	C_2	Σ_1	Σ_2	C_2
L	L	L	L	L	L	L	H	L	L
L	L	L	H	L	L	L	L	H	L
L	L	L	L	L	L	L	L	H	L
L	L	L	H	L	L	L	L	H	L
L	L	H	L	L	L	L	L	L	H
L	L	H	H	L	L	L	L	L	H
L	L	L	L	L	L	L	L	L	H
L	L	L	H	L	L	L	L	L	H
L	L	H	L	L	L	L	L	L	H
L	L	H	H	L	L	L	L	L	H
L	H	L	L	L	L	L	L	L	H
L	H	L	H	L	L	L	L	L	H
L	H	H	L	L	L	L	L	L	H
L	H	H	H	L	L	L	L	L	H
H	L	L	L	L	L	L	L	L	H
H	L	L	H	L	L	L	L	L	H
H	L	L	L	L	L	L	L	L	H
H	L	L	H	L	L	L	L	L	H
H	L	H	L	L	L	L	L	L	H
H	L	H	H	L	L	L	L	L	H
H	H	L	L	L	L	L	L	L	H
H	H	L	H	L	L	L	L	L	H
H	H	H	L	L	L	L	L	L	H
H	H	H	H	L	L	L	L	L	H

H = high level, L = low level

NOTE: Input conditions at A1, B1, A2, B2, and C0 are used to determine outputs Σ_1 and Σ_2 and the value of the internal carry C_2 . The values at C_2 , A3, B3, A4, and B4 are then used to determine outputs Σ_3 , Σ_4 , and C_4 .

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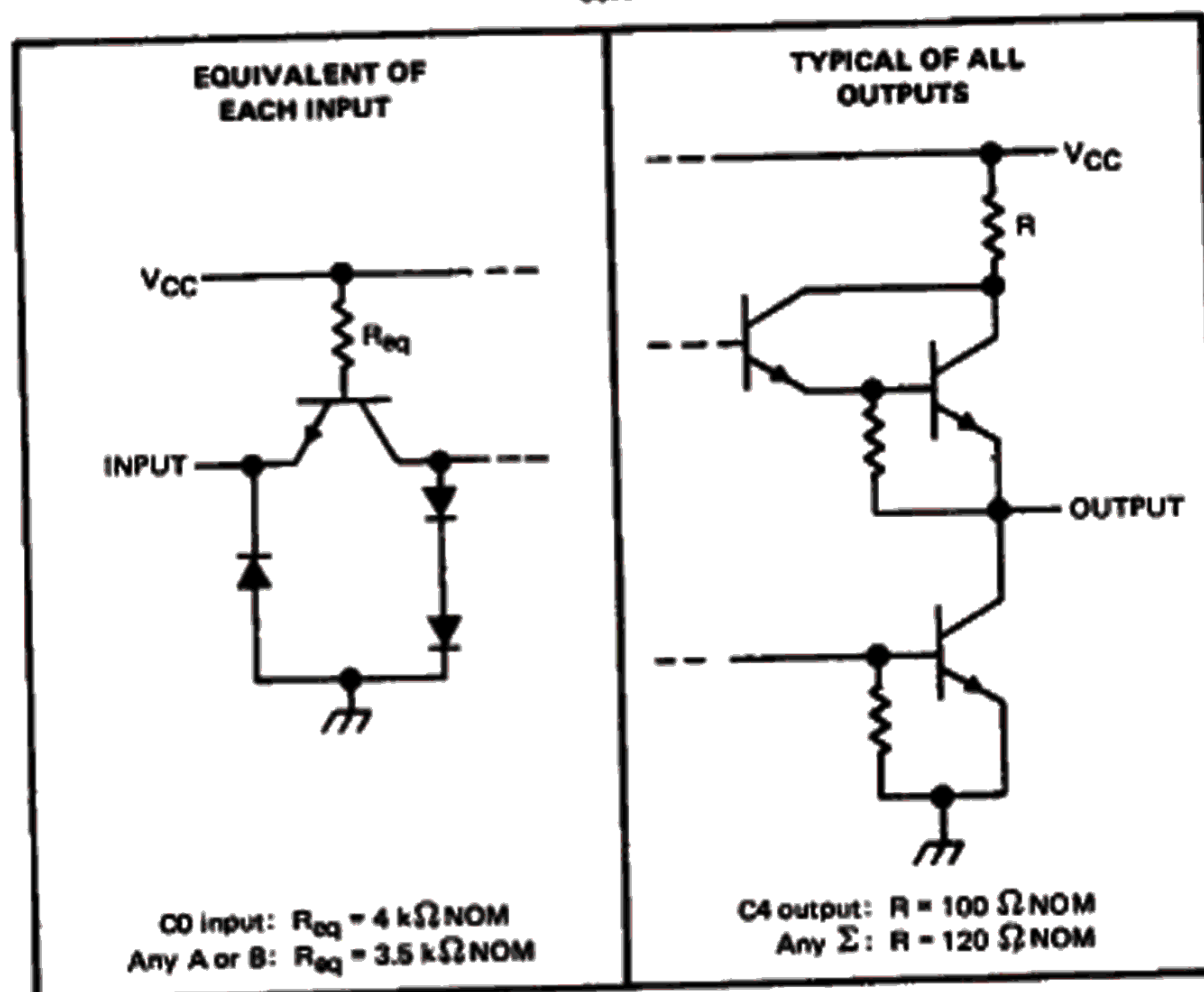
SN5483A, SN54LS83A, SN7483A, SN74LS83A
4-BIT BINARY FULL ADDERS WITH FAST CARRY

schematics of inputs and outputs

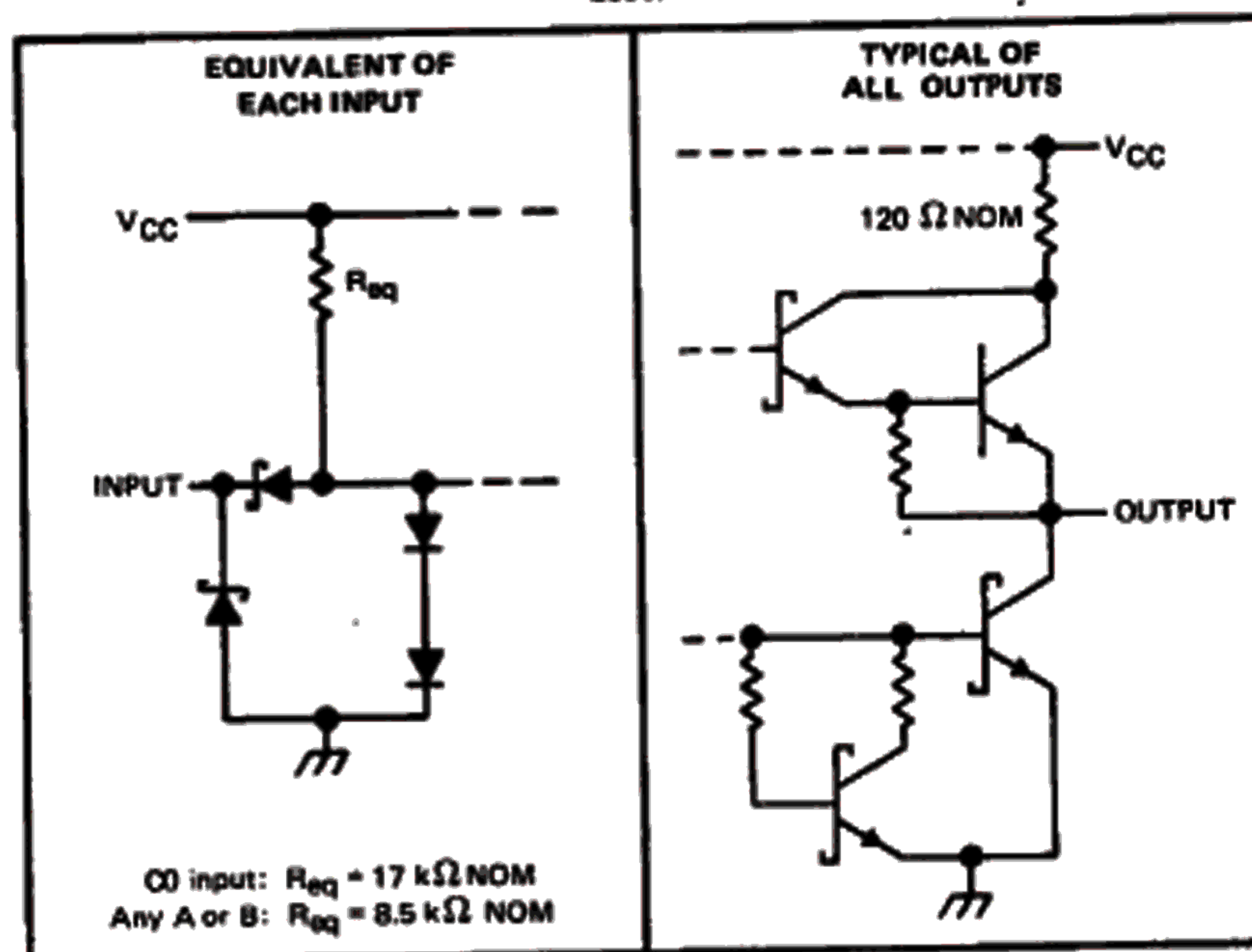
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'83A

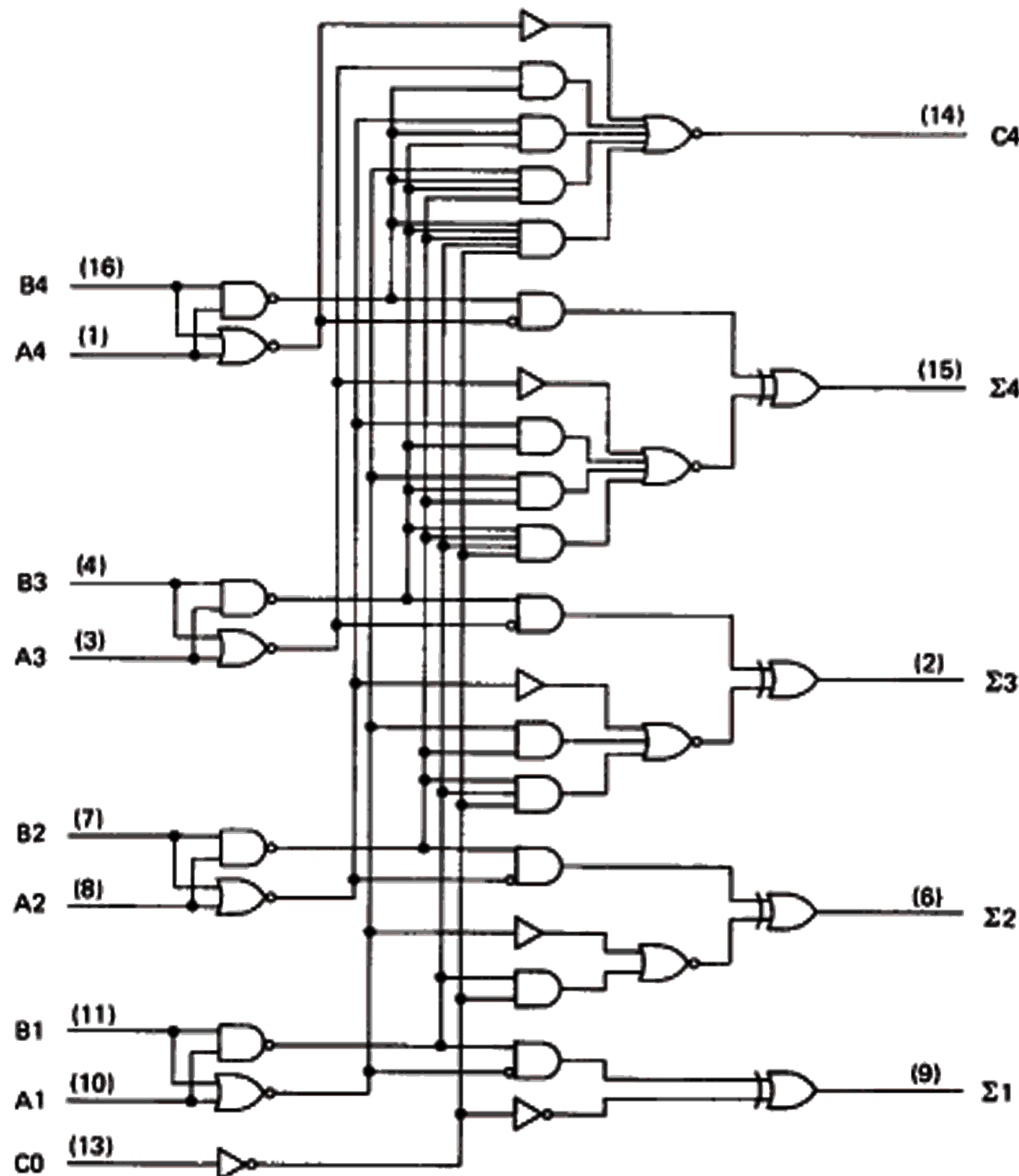


'LS83A



SN5483A, SN54LS83A, SN7483A, SN74LS83A 4-BIT BINARY FULL ADDERS WITH FAST CARRY

logic diagram (positive logic)



Pin numbers shown are for D, J, N, and W packages.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage: '83A	5.5 V
'LS83A	7 V
Interemitter voltage (see Note 2)	5.5 V
Operating free-air temperature range: SN5483A, SN54LS83A	-55°C to 125°C
SN7483A, SN74LS83A	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTES: 1. Voltage values, except interemitter voltage, are with respect to network ground terminal.

2. This is the voltage between two emitters of a multiple-emitter transistor. This rating applies for the '83A only between the following pairs: A1 and B1, A2 and B2, A3 and B3, A4 and B4.

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SN5483A, SN7483A 4-BIT BINARY FULL ADDERS WITH FAST CARRY

recommended operating conditions

		SN5483A			SN7483A			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply Voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}	Any output except C4	-800			-800			μA
	Output C4	-400			-400			
Low-level output current, I_{OL}	Any output except C4	16			16			mA
	Output C4	8			8			
Operating free-air temperature, T_A		-55			0			$^{\circ}C$

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		SN5483A			SN7483A			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
V_{IH}	High-level input voltage	2			2			V
V_{IL}	Low-level input voltage			0.8			0.8	V
V_{IK}	Input clamp voltage	$V_{CC} = \text{MIN.}, I_I = -12 \text{ mA}$			-1.5			V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN.}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = \text{MAX}$			2.4	3.4		V
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN.}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = \text{MAX}$				0.2	0.4	V
I_I	Input current at maximum input voltage	$V_{CC} = \text{MAX.}, V_I = 5.5 \text{ V}$					1	mA
I_{IH}	High-level input current	$V_{CC} = \text{MAX.}, V_I = 2.4 \text{ V}$					40	μA
I_{IL}	Low-level input current	$V_{CC} = \text{MAX.}, V_I = 0.4 \text{ V}$					-1.6	mA
I_{OS}	Short-circuit output current §	Any output except C4	$V_{CC} = \text{MAX.}$		-20		-55	mA
		Output C4			-20		-70	
I_{CC}	Supply current	$V_{CC} = \text{MAX.},$ Outputs open	All B low, other inputs at 4.5 V	56		56		mA
			All inputs at 4.5 V	66	99	66	110	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^{\circ}C$.

§ Only one output should be shorted at a time.

switching characteristics, $V_{CC} = 5 \text{ V}, T_A = 25^{\circ}C$

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	C0	Any Σ	$C_L = 15 \text{ pF}, R_L = 400 \Omega,$ See Note 3	14	21		ns
t_{PHL}				12	21		
t_{PLH}	A_i or B_i	Σ_j	$C_L = 15 \text{ pF}, R_L = 400 \Omega,$ See Note 3	16	24		ns
t_{PHL}				16	24		
t_{PLH}	C0	C4	$C_L = 15 \text{ pF}, R_L = 780 \Omega,$ See Note 3	9	14		ns
t_{PHL}				11	16		
t_{PLH}	A_i or B_i	C4	$C_L = 15 \text{ pF}, R_L = 780 \Omega,$ See Note 3	9	14		ns
t_{PHL}				11	16		

† t_{PLH} = propagation delay time, low-to-high-level output

t_{PHL} = propagation delay time, high-to-low-level output

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

SN54LS83A, SN74LS83A 4-BIT BINARY FULL ADDERS WITH FAST CARRY

recommended operating conditions

	SN54LS83A			SN74LS83A			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}			-400			-400	μA
Low-level output current, I_{OL}			4			8	mA
Operating free-air temperature, T_A	-55		125	0		70	$^{\circ}C$

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	SN54LS83A			SN74LS83A			UNIT
			MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH}	High-level input voltage		2			2			V
V_{IL}	Low-level input voltage				0.7			0.8	V
V_{IK}	Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$			-1.5			-1.5	V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OH} = -400 \mu A$	2.5	3.4		2.7	3.4		V
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, I_{OL} = 4 \text{ mA}$	0.25	0.4		0.25	0.4		V
		$V_{IL} = V_{IL \text{ max}}, I_{OL} = 8 \text{ mA}$				0.35	0.5		
I_I	Input current at maximum input voltage	Any A or B			0.2			0.2	mA
		C0			0.1			0.1	
I_{IH}	High-level input current	Any A or B			40			40	μA
		C0			20			20	
I_{IL}	Low-level input current	Any A or B			-0.8			-0.8	mA
		C0			-0.4			-0.4	
I_{OS}	Short-circuit output current‡	$V_{CC} = \text{MAX}$	-20		-100	-20		-100	mA
I_{CC}	Supply current	All inputs grounded	22		39	22		39	mA
		All B low, other inputs at 4.5 V	19		34	19		34	
		All inputs at 4.5 V	19		34	19		34	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^{\circ}C$.

§ Only one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

switching characteristics, $V_{CC} = 5 \text{ V}, T_A = 25^{\circ}C$

PARAMETER ¹	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH}	C0	Any Σ	$C_L = 15 \text{ pF},$ See Note 3	$R_L = 2 \text{ k}\Omega,$	16	24	ns	
t_{PHL}					15	24		
t_{PLH}	A_i or B_i	Σ_i			15	24	ns	
t_{PHL}					15	24		
t_{PLH}	C0	C4			11	17	ns	
t_{PHL}					15	22		
t_{PLH}	A_i or B_i	C4			11	17	ns	
t_{PHL}					12	17		

§ t_{PLH} = propagation delay time, low-to-high-level output

t_{PHL} = propagation delay time, high-to-low-level output

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

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