

SN54283, SN54LS283, SN54S283, SN74283, SN74LS283, SN74S283 4-BIT BINARY FULL ADDERS WITH FAST CARRY

OCTOBER 1976 — REVISED MARCH 1988

- Full-Carry Look-Ahead Across the Four Bits
- Systems Achieve Partial Look-Ahead Performance with the Economy of Ripple Carry
- Supply Voltage and Ground on Corner Pins to Simplify P-C Board Layout

TYPICAL ADD TIMES

TYPE	TWO		TYPICAL POWER DISSIPATION PER ADDER
	8-BIT WORDS	16-BIT WORDS	
'283	23ns	43ns	310 mW
'LS283	25ns	45ns	95 mW
'S283	15ns	30ns	510 mW

description

The '283 and 'LS283 adders are electrically and functionally identical to the '83A and 'LS83A, respectively; only the arrangement of the terminals has been changed. The 'S283 high performance versions are also functionally identical.

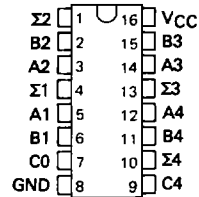
These improved full adders perform the addition of two 4-bit binary words. The sum (Σ) outputs are provided for each bit and the resultant carry (C4) is obtained from the fourth bit. These adders feature full internal look-ahead across all four bits generating the carry term in ten nanoseconds, typically, for the '283 and 'LS283, and 7.5 nanoseconds for the 'S283. This capability 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. End around carry can be accomplished without the need for logic or level inversion.

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

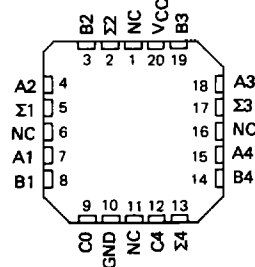
SN54283, SN54LS283 . . . J OR W PACKAGE
SN54S283 . . . J PACKAGE
SN74283 . . . N PACKAGE
SN74LS283, SN74S283 . . . D OR N PACKAGE

(TOP VIEW)



SN54LS283, SN54S283 . . . FK PACKAGE

(TOP VIEW)



NC - No internal connection

FUNCTION TABLE

INPUT		OUTPUT											
		WHEN C0 = L						WHEN C0 = H					
		WHEN C2 = L			WHEN C2 = H			WHEN C2 = L		WHEN C2 = H			
A1	B1	A2	B2	Σ1	Σ2	C2	C0	Σ3	Σ4	C4	Σ3	Σ4	C4
L	L	L	L	L	L	L	L	H	L	L	L	L	L
L	L	L	L	L	L	L	L	L	L	L	H	L	L
L	L	L	L	L	L	L	H	L	L	L	L	L	L
L	L	L	L	L	L	H	L	L	L	H	L	L	L
L	L	L	L	L	L	H	H	L	L	L	L	L	L
L	L	L	L	L	L	H	H	L	L	H	L	L	L
L	L	L	L	L	L	H	H	L	L	L	L	L	L
L	L	L	L	L	L	H	L	L	L	H	L	L	L
L	L	L	L	L	L	H	H	L	L	H	L	L	L
L	L	L	L	L	L	H	L	L	L	H	H	L	L
L	L	L	L	L	L	H	H	L	L	L	L	L	L
L	L	L	L	L	L	H	H	L	L	L	L	L	L
L	L	L	L	L	L	H	L	L	L	L	H	L	L
L	L	L	L	L	L	H	H	L	L	L	L	L	L
L	L	L	L	L	L	H	L	L	L	L	L	L	L
L	L	L	L	L	L	H	H	L	L	H	L	L	L

H = high level, L = low level

NOTE: Input conditions at A1, B1, A2, B2, and C0 are used to determine outputs $\Sigma 1$ and $\Sigma 2$ and the value of the internal carry C2. The values at C2, A3, B3, A4, and B4 are then used to determine outputs $\Sigma 3$, $\Sigma 4$, and C4.

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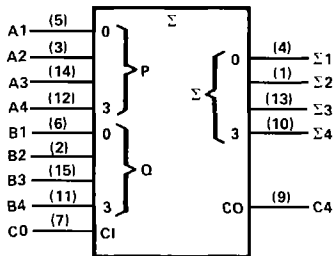
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TEXAS INSTRUMENTS

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SN54283, SN54LS283, SN54S283, SN74283, SN74LS283, SN74S283 4-BIT BINARY FULL ADDERS WITH FAST CARRY

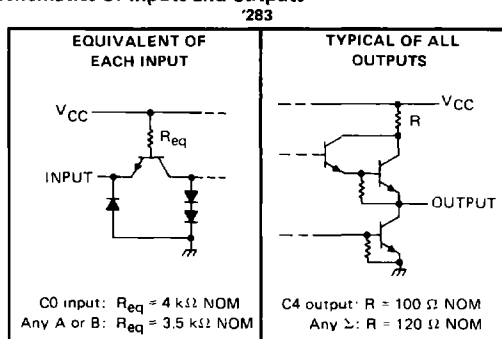
logic symbol†



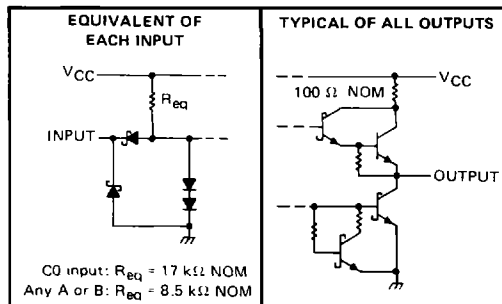
† This symbol is in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12

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

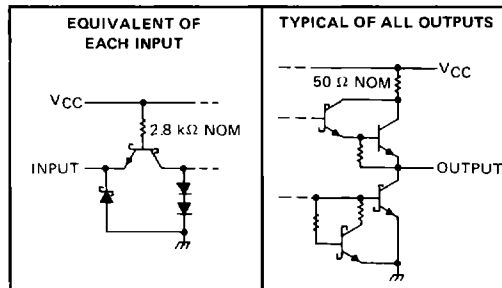
schematics of inputs and outputs



'LS283



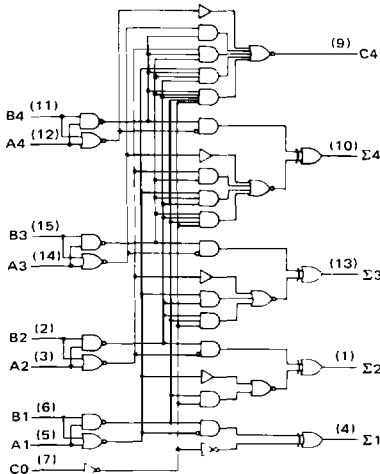
'S283



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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)	7V
Input voltage: '283, 'S283	5.5V
'LS283	7V
Interemitter voltage (see Note 2)	5.5V
Operating free-air temperature range: SN54283, SN54LS283, SN54S283	-55°C to 125°C
SN74283, SN74LS283, SN74S283	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 '283 and 'S283 only between the following pairs: A1 and B1, A2 and B2, A3 and B3, A4 and B4

SN54283, SN74283 4-BIT BINARY FULL ADDERS WITH FAST CARRY

recommended operating conditions

		SN54283			SN74283			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			μ A
	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	125		0	70		$^{\circ}$ C

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

PARAMETER		TEST CONDITIONS [†]	SN54283			SN74283			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			-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	3.6		2.4	3.6		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		0.2	0.4	V
I_I	Input current at maximum input voltage	$V_{CC} = \text{MAX.}, V_I = 5.5 \text{ V}$			1			1	mA
I_{IH}	High-level input current	$V_{CC} = \text{MAX.}, V_I = 2.4 \text{ V}$			40			40	μ A
I_{IL}	Low-level input current	$V_{CC} = \text{MAX.}, V_I = 0.4 \text{ V}$			-1.6			-1.6	mA
I_{OS}	Short-circuit output current [§]	Any output except C4	$V_{CC} = \text{MAX}$			-20	-55	-55	mA
		Output C4	$V_{CC} = \text{MAX}$			-20	-70	-18	
I_{CC}	Supply current	$V_{CC} = \text{MAX.},$ All B low, other inputs at 4.5 V Outputs open				56		56	mA
						66	99	66	

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

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

[§]Only one output should be shorted at a time

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

PARAMETER [¶]	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	C0	Any Δ	$C_L = 15 \text{ pF.}, R_L = 400 \Omega.$ See Note 3	14	21	ns	
t_{PHL}				12	21		
t_{PLH}	A_i or B_i	Δ_i		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		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

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SN54LS283, SN74LS283

4-BIT BINARY FULL ADDERS WITH FAST CARRY

recommended operating conditions

	SN54LS283			SN74LS283			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			μ A	
Low-level output current, I_{OL}	4			8			mA	
Operating free-air temperature, T_A	-55			125			0	$^{\circ}$ C

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

PARAMETER		TEST CONDITIONS†	SN54LS283			SN74LS283			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	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OH} = -400 \mu\text{A}$	2.5	3.4		2.7	3.4		V
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OL} = 4 \text{ mA}$ $I_{OL} = 8 \text{ mA}$	0.25	0.4		0.25	0.4		V
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	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$	40			40			μ A
I_{IL}	Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$	-0.8			-0.8			mA
I_{OS}	Short-circuit output current§	$V_{CC} = \text{MAX}$	-20	-100		-20	-100		mA
I_{CC}	Supply current	$V_{CC} = \text{MAX},$ Outputs open	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 $V_{CC} = 5 \text{ V}, T_A = 25^{\circ}\text{C}$.

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

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

PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	C0	Any Σ	$C_L = 15 \text{ pF}, R_L = 2 \text{ k}\Omega,$ See Note 3	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}				11	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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TTL Devices

SN54S283, SN74S283 4-BIT BINARY FULL ADDERS WITH FAST CARRY

recommended operating conditions

		SN54S283			SN74S283			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	-1			-1			mA
	Output C4	-500			-500			μ A
Low-level output current, I_{OL}	Any output except C4	20			20			mA
	Output C4	10			10			
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 [†]		MIN	TYP [‡]	MAX	UNIT
V_{IH}	High-level input voltage			2			V
V_{IL}	Low-level input voltage					0.8	V
V_{IK}	Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$				-1.2	V
V_{OH}	High-level output voltage	SN54S283	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}$	2.5	3.4		V
		SN74S283	$V_{IL} = 0.8 \text{ V}, I_{OH} = \text{MAX}$	2.7	3.4		
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = \text{MAX}$				0.5	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	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$				50	μ A
I_{IL}	Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.5 \text{ V}$				-2	mA
I_{OS}	Short-circuit output current [§]	Any output except C4	$V_{CC} = \text{MAX}$	-40		-100	mA
		Output C4		-20		-100	
I_{CC}	Supply current	$V_{CC} = \text{MAX},$ Outputs open	All B low, other inputs at 4.5 V	80			mA
			All inputs at 4.5 V	95	160		

[†]For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable device type.

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

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

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

PARAMETER [†]	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
t_{PLH}	C0	Any Σ	$C_L = 15 \text{ pF}, R_L = 280 \Omega,$ See Note 3	11		18	ns	
t_{PHL}				12		18		
t_{PLH}	A _i or B _i	Σ_i		12		18	ns	
t_{PHL}				11.5		18		
t_{PLH}	C0	C4		$C_L = 15 \text{ pF}, R_L = 560 \Omega,$ See Note 3	6		11	ns
t_{PHL}					7.5		11	
t_{PLH}	A _i or B _i	C4	7.5		12	ns		
t_{PHL}			8.5		12			

[†] 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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