

SN54284, SN54285, SN74284, SN74285 **4-BIT BY 4-BIT PARALLEL BINARY MULTIPLIERS**

MAY 1972 — REVISED MARCH 1988

- Fast Multiplication of Two Binary Numbers
8-Bit Product in 40 ns Typical
- Expandable for N-Bit-by-n-Bit Applications:
16-Bit Product in 70 ns Typical
32-Bit Product in 103 ns Typical
- Fully Compatible with Most TTL Circuits
- Diode-Clamped Inputs Simplify System Design

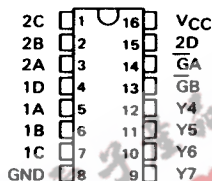
description

These high-speed TTL circuits are designed to be used in high-performance parallel multiplication applications. When connected as shown in Figure A, these circuits perform the positive-logic multiplication of two 4-bit binary words. The eight-bit binary product is generated with typically only 40 nanoseconds delay.

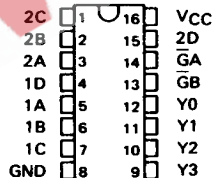
This basic four-by-four multiplier can be utilized as a fundamental building block for implementing larger multipliers. For example, the four-by-four building blocks can be connected as shown in Figure B to generate submultiple partial products. These results can then be summed in a Wallace tree, and, as illustrated, will produce a 16-bit product for the two eight-bit words typically in 70 nanoseconds. SN54H183/SN74H183 carry-save adders and SN54S181/SN74S181 arithmetic logic units with the SN54S182/SN74S182 look-ahead generator are used to achieve this high performance. The scheme is expandable for implementing $N \times M$ bit multipliers.

The SN54284 and SN54285 are characterized for operation over the full military temperature range of -55°C to 125°C ; the SN74284 and SN74285 are characterized for operation from 0°C to 70°C .

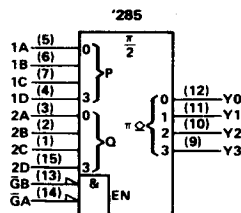
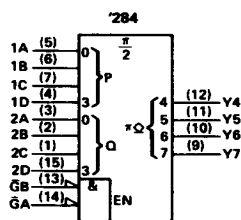
SN54284 . . . J OR W PACKAGE
SN74284 . . . N PACKAGE
(TOP VIEW)



SN54285 . . . J OR W PACKAGE
SN74285 . . . N PACKAGE
(TOP VIEW)



logic symbols†



†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

2

TTL Devices

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schematics

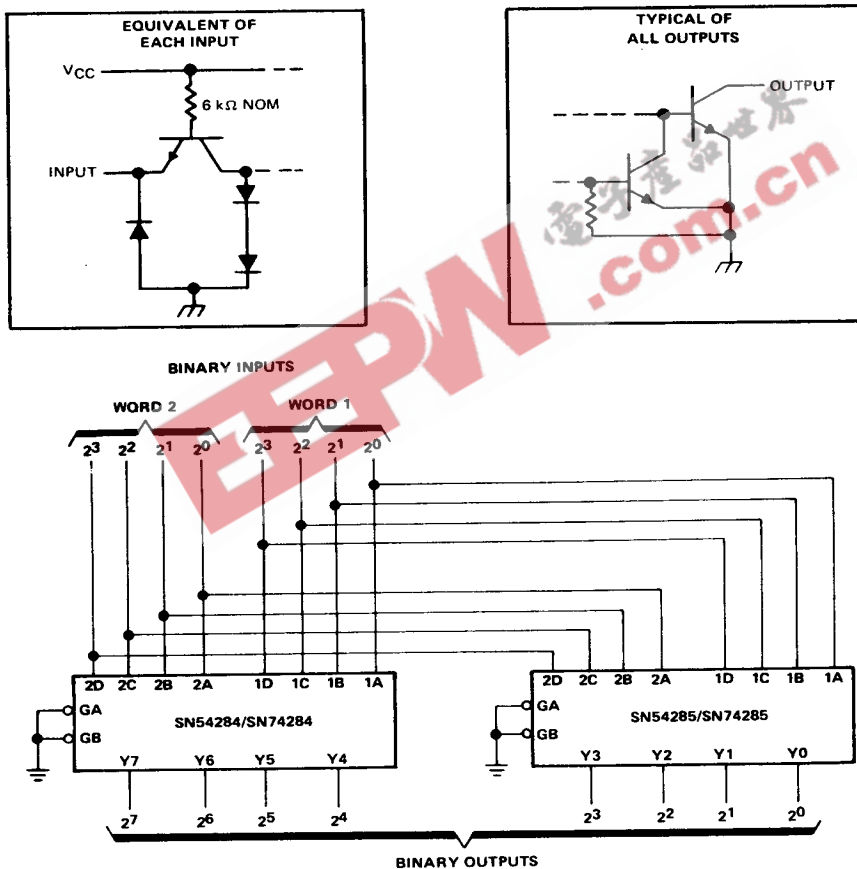


FIGURE A-4 X 4 MULTIPLIER

SN54284, SN54285, SN74284, SN74285
4-BIT BY 4-BIT PARALLEL BINARY MULTIPLIERS

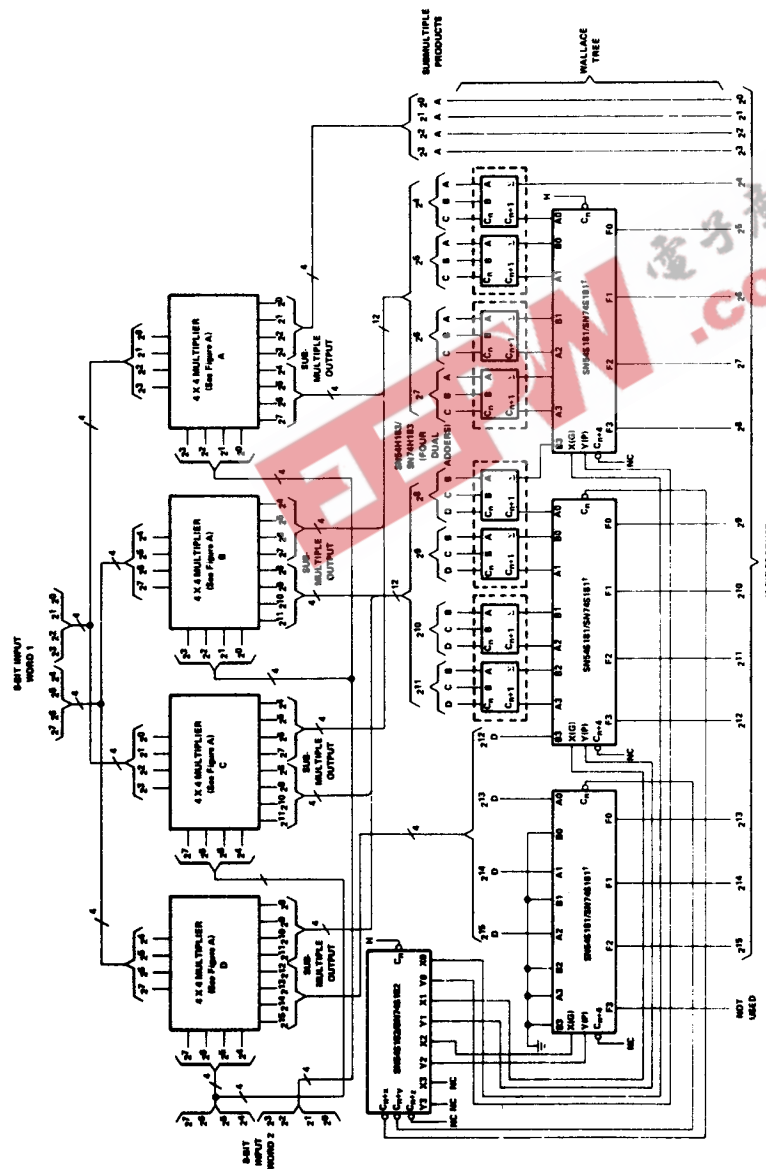


FIGURE 8-8 X 8 MULTIPLIER

¹Other terminals of the three SN54S181/SN74S181 ALU's are connected as follows: S3 = H, S2 = L, S1 = L, S0 = H, M = L, Output A = B if not used for this application.

SN54284, SN54285, SN74284, SN74285 4-BIT BY 4-BIT PARALLEL BINARY MULTIPLIERS

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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage	5.5 V
Operating free-air temperature range: SN54 [†] Circuits	-55°C to 125°C
SN74 [†] Circuits	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

	SN54284			SN74284			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 voltage, V_{OH}			5.5			5.5	V
Low-level output current, I_{OL}			16			16	mA
Operating free-air temperature, T_A	-55		125	0		70	°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_I Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -12 \text{ mA}$			-1.5	V
I_{OH} High-level output current	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, V_{OH} = 5.5 \text{ V}$			40	μA
V_{OL} Low-level output voltage	$V_{CC} = \text{MIN}, I_{OL} = 12 \text{ mA}$			0.4	V
	$V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = 16 \text{ mA}$			0.45	
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	mA
I_{CC} Supply current	$V_{CC} = \text{MAX}, T_A = 125^\circ\text{C},$ See Note 2			99	mA
	$V_{CC} = \text{MAX},$ See Note 2			92	
	$V_{CC} = \text{MAX},$ See Note 2			130	

[†]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 $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$.

NOTE 2: With outputs open and both enable inputs grounded, I_{CC} is measured first by selecting an output product which contains three or more high-level bits, then by selecting an output product which contains four low-level bits.

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH} Propagation delay time, low-to-high-level output from enable	$C_L = 30 \text{ pF}$ to GND, $R_{L1} = 300 \Omega$ to V_{CC} ,	20	30		ns
t_{PHL} Propagation delay time, high-to-low-level output from enable	$R_{L2} = 600 \Omega$ to GND,	20	30		
t_{PLH} Propagation delay time, low-to-high-level output from word inputs	See Note 3	40	60		ns
t_{PHL} Propagation delay time, high-to-low-level output from word inputs		40	60		

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