

# 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

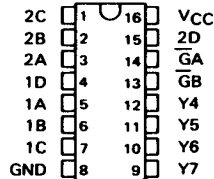
## description

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.

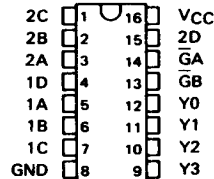
This basic four-by-four multiplier can be utilized as a fundamental building block for implementing larger multipliers. For example, the four-by-four building blocks can be connected as shown in Figure B to generate submultiple partial products. These results can then be summed in a Wallace tree, and, 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  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ ; the SN74284 and SN74285 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

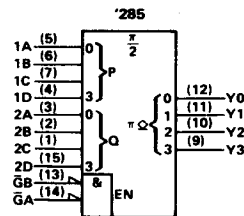
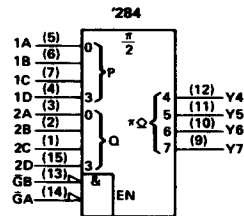
SN54284 . . . J OR W PACKAGE  
SN74284 . . . N PACKAGE  
(TOP VIEW)



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.

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INSTRUMENTS

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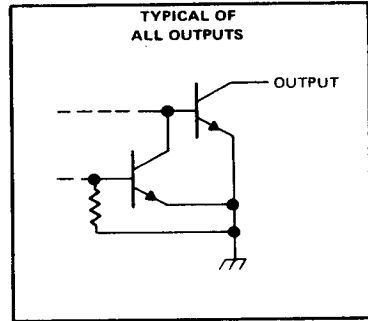
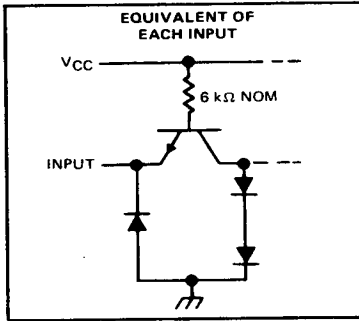
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TTL Devices

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

schematics



2

TTL Devices

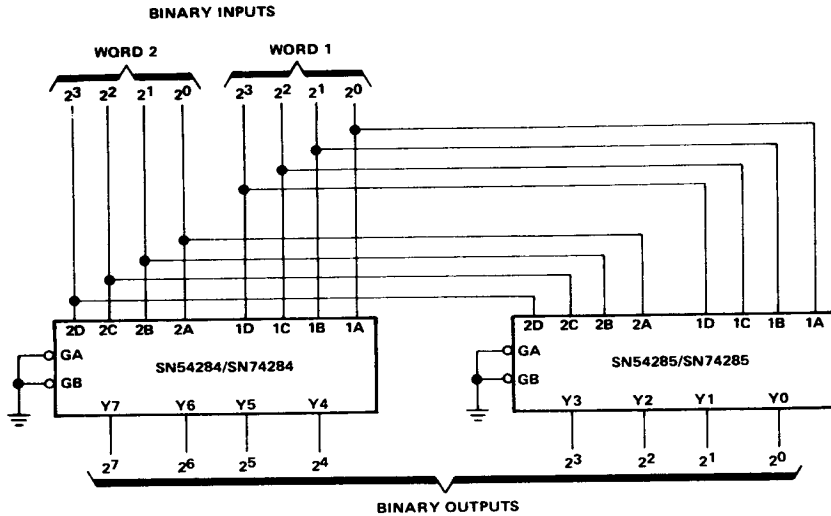
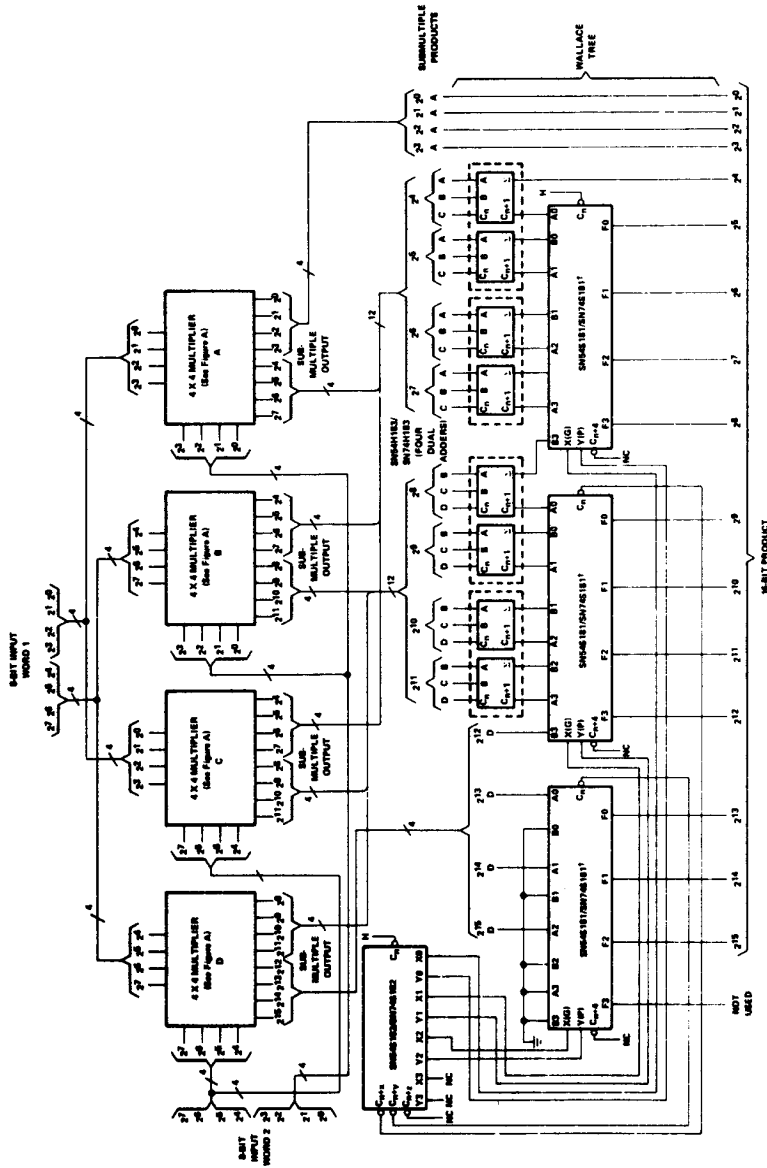


FIGURE A-4 X 4 MULTIPLIER

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



**FIGURE 8-9 X 8 MULTIPLIER**

<sup>1</sup>Other 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 is not used for this application.

**2**  
**TTL Devices**

# 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 <sup>†</sup> Circuits	-55°C to 125°C
SN74 <sup>†</sup> 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			0			70 °C

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

PARAMETER	TEST CONDITIONS <sup>†</sup>	MIN	TYP <sup>‡</sup>	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			$\mu\text{A}$	
$V_{OL}$ Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}$	$I_{OL} = 12 \text{ mA}$	0.4		V	
		$I_{OL} = 16 \text{ mA}$	0.45			
$I_I$ Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$	40			mA	
$I_{IH}$ High-level input current	$V_{CC} = \text{MAX}, V_I = 2.4 \text{ V}$	-1			mA	
$I_{IL}$ Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$					
$I_{CC}$ Supply current	$V_{CC} = \text{MAX}, T_A = 125^\circ\text{C},$ See Note 2	SN54284, SN54285 N package only			99	mA
	$V_{CC} = \text{MAX},$ See Note 2	SN54284, SN54285			92 110	
	$V_{CC} = \text{MAX},$ See Note 2	SN74284, SN74285			92 130	

<sup>†</sup>For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable device type.

<sup>‡</sup>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 $V_{CC}$ , $R_{L2} = 600 \Omega$ to GND, See Note 3	20		30	ns
$t_{PHL}$ Propagation delay time, high-to-low-level output from enable		20		30	
$t_{PLH}$ Propagation delay time, low-to-high-level output from word inputs		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.

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# Texas Instruments

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