

# SN54HC133, SN74HC133 13-INPUT POSITIVE-NAND GATES

D2684, DECEMBER 1982—REVISED SEPTEMBER 1987

- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs

- Dependable Texas Instruments Quality and Reliability

## description

These devices contain a single 13-input NAND gate. They perform the Boolean functions in positive logic:

$$Y = \overline{A \cdot B \cdot C \cdot D \cdot E \cdot F \cdot G \cdot H \cdot I \cdot J \cdot K \cdot L \cdot M}$$

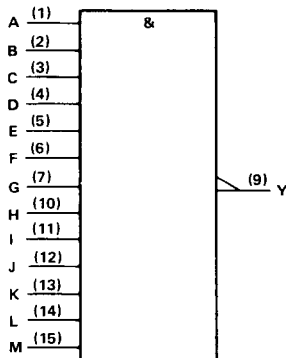
$$Y = \overline{A + B + C + D + E + F + G + H + I + J + K + L + M}$$

The SN54HC133 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HC133 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

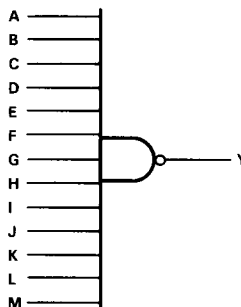
FUNCTION TABLE

INPUTS A THRU M	OUTPUT Y
All inputs H	L
One or more inputs L	H

## logic symbol†



## logic diagram (positive logic)

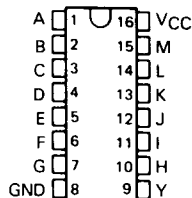


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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

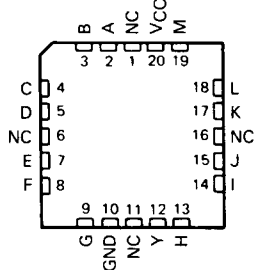
### SN54HC133 . . . J PACKAGE SN74HC133 . . . D OR N PACKAGE

(TOP VIEW)



### SN54HC133 . . . FK PACKAGE

(TOP VIEW)



NC—No internal connection

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HCMOS Devices

# SN54HC133, SN74HC133

## 13-INPUT POSITIVE-NAND GATES

### absolute maximum ratings over operating free-air temperature range†

Supply voltage, $V_{CC}$ .....	-0.5 V to 7 V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) .....	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) .....	$\pm 20$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....	$\pm 25$ mA
Continuous current through $V_{CC}$ or GND pins .....	$\pm 50$ mA
Lead temperature 1,6 mm (1/16 in) from case for 60 s: FK or J package .....	300 °C
Lead temperature 1,6 mm (1/16 in) from case for 10 s: D or N package .....	260 °C
Storage temperature range .....	-65 °C to 150 °C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

### recommended operating conditions

		SN54HC133			SN74HC133			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	2	5	6	2	5	6	V
$V_{IH}$	High-level input voltage	$V_{CC} = 2$ V	1.5		1.5			V
		$V_{CC} = 4.5$ V	3.15		3.15			
		$V_{CC} = 6$ V	4.2		4.2			
$V_{IL}$	Low-level input voltage	$V_{CC} = 2$ V	0	0.3	0	0.3		V
		$V_{CC} = 4.5$ V	0	0.9	0	0.9		
		$V_{CC} = 6$ V	0	1.2	0	1.2		
$V_I$	Input voltage	0	$V_{CC}$		0	$V_{CC}$		V
$V_O$	Output voltage	0	$V_{CC}$		0	$V_{CC}$		V
$t_t$	Input transition (rise and fall) times	$V_{CC} = 2$ V	0	1000	0	1000		ns
		$V_{CC} = 4.5$ V	0	500	0	500		
		$V_{CC} = 6$ V	0	400	0	400		
$T_A$	Operating free-air temperature	-55	125		-40	85		°C

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

PARAMETER	TEST CONDITIONS	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC133		SN74HC133		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$V_{OH}$	$V_I = V_{IH}$ or $V_{IL}$ , $I_{OH} = -20 \mu\text{A}$	2 V	1.9	1.998		1.9	1.9		V	
		4.5 V	4.4	4.499		4.4	4.4			
		6 V	5.9	5.999		5.9	5.9			
	$V_I = V_{IH}$ or $V_{IL}$ , $I_{OH} = -4 \text{ mA}$	4.5 V	3.98	4.30		3.7	3.84			
	$V_I = V_{IH}$ or $V_{IL}$ , $I_{OH} = -5.2 \text{ mA}$	6 V	5.48	5.80		5.2	5.34			
$V_{OL}$	$V_I = V_{IH}$ or $V_{IL}$ , $I_{OL} = 20 \mu\text{A}$	2 V	0.002	0.1		0.1	0.1		V	
		4.5 V	0.001	0.1		0.1	0.1			
		6 V	0.001	0.1		0.1	0.1			
	$V_I = V_{IH}$ or $V_{IL}$ , $I_{OL} = 4 \text{ mA}$	4.5 V	0.17	0.26		0.4	0.33			
	$V_I = V_{IH}$ or $V_{IL}$ , $I_{OL} = 5.2 \text{ mA}$	6 V	0.15	0.26		0.4	0.33			
$I_I$	$V_I = V_{CC}$ or 0	6 V	$\pm 0.1$ $\pm 100$		$\pm 1000$		$\pm 1000$		nA	
$I_{CC}$	$V_I = V_{CC}$ or 0, $I_O = 0$	6 V	2		40		20		$\mu\text{A}$	
$C_i$		2 to 6 V	3	10	10	10	10	pF		

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**SN54HC133, SN74HC133**  
**13-INPUT POSITIVE-NAND GATES**

switching characteristics over recommended operating free-air temperature range (unless otherwise noted),  $C_L = 50$  pF (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub>	T <sub>A</sub> = 25°C			SN54HC133		SN74HC133		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t <sub>pd</sub>	Any	Y	2 V	70	150		225		190	ns	
			4.5 V	16	30		45		38		
			6 V	13	26		38		33		
t <sub>t</sub>		Y	2 V	38	75		110		95	ns	
			4.5 V	8	15		22		19		
			6 V	6	13		19		16		

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HC MOS Devices

C <sub>pd</sub>	Power dissipation capacitance	No load, T <sub>A</sub> = 25°C	24 pF typ
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NOTE 1: Load circuit and voltage waveforms are shown in Section 1.