

13 INPUT NAND GATE

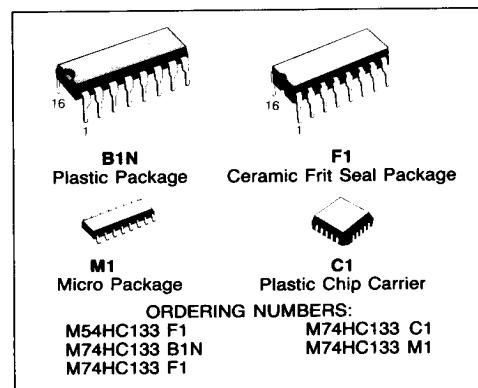
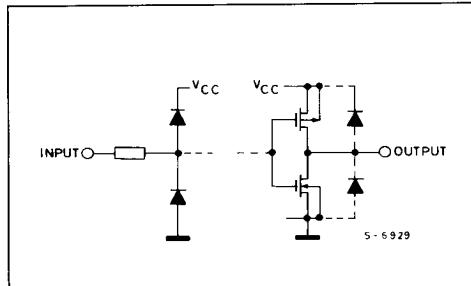
- HIGH SPEED
 $t_{PD} = 18 \text{ ns (TYP.)}$ at $V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION
 $I_{CC} = 1 \mu\text{A}$ (MAX.) at $T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (MIN.)
- OUTPUT DRIVE CAPABILITY
10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE
 $|I_{OH}| = |I_{OL}| = 4 \text{ mA}$ (MIN.)
- BALANCED PROPAGATION DELAYS
 $t_{PLH} = t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE
 V_{CC} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE
WITH 54/74LS133

DESCRIPTION

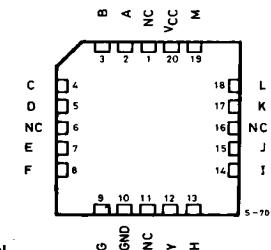
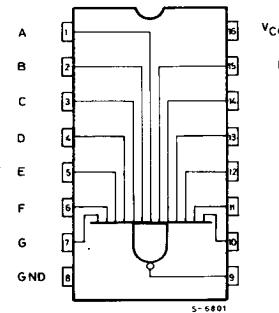
The M54/74HC133 is a high speed CMOS 13-INPUT NAND GATE fabricated in silicon gate CMOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption.

The internal circuit is composed of 7 stages including buffer output, which gives high noise immunity and stable output. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

INPUT AND OUTPUT EQUIVALENT CIRCUIT

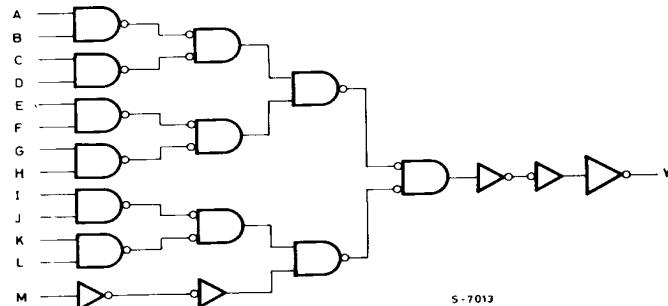


PIN CONNECTIONS (top view)



NC =
No Internal Connection

LOGIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V _{CC}	Supply Voltage	0.5 to 7	V
V _I	DC Input Voltage	-0.5 to V _{CC} + 0.5	V
V _O	DC Output Voltage	-0.5 to V _{CC} + 0.5	V
I _{IK}	DC Input Diode Current	± 20	mA
I _{OK}	DC Output Diode Current	± 20	mA
I _O	DC Output Source Sink Current Per Output Pin	± 25	mA
I _{CC} or I _{GND}	DC V _{CC} or Ground Current	± 50	mA
P _D	Power Dissipation	500 (*)	mW
T _{stg}	Storage Temperature	-65 to 150	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

(*) 500 mW: ≈ 65°C derate to 300 mW by 10 mW/°C: 65°C to 85°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V _{CC}	Supply Voltage	2 to 6	V
V _I	Input Voltage	0 to V _{CC}	V
V _O	Output Voltage	0 to V _{CC}	V
T _A	Operating Temperature 74HC Series 54HC Series	- 40 to 85 - 55 to 125	°C
t _r , t _f	Input Rise and Fall Time	V _{CC} { 2 V 0 to 1000 4.5V 0 to 500 6 V 0 to 400	ns

DC SPECIFICATIONS

Symbol	Parameter	V _{CC}	Test Condition	T _A = 25°C 54HC and 74HC			- 40 to 85°C 74HC		- 55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V _{IH}	High Level Input Voltage	2.0 4.5 6.0		1.5 3.15 4.2	— — —	— — 4.2	1.5 3.15 4.2	— — —	1.5 3.15 4.2	— — —	V
V _{IL}	Low Level Input Voltage	2.0 4.5 6.0		— — —	— — —	0.5 1.35 1.8	— — —	0.5 1.35 1.8	— — —	0.5 1.35 1.8	V
V _{OH}	High Level Output Voltage	2.0 4.5 6.0 4.5 6.0	V _I	I _O	1.9 4.4 5.9	2.0 4.5 6.0	— — —	1.9 4.4 5.9	— — —	1.9 4.4 5.9	— — —
			V _{IH} or V _{IL}	- 20 μA - 4.0 mA - 5.2 mA	4.18 5.68	4.31 5.8	— —	4.13 5.63	— —	4.10 5.60	— —
V _{OL}	Low Level Output Voltage	2.0 4.5 6.0 4.5 6.0	V _{IH} or V _{IL}	20 μA	— — —	0 0.1 0.1	— — —	0.1 0.1 0.1	— — —	0.1 0.1 0.1	— — —
				4.0 mA 5.2 mA	— —	0.17 0.18	0.26 0.26	— —	0.33 0.33	— —	0.40 0.40
I _I	Input Leakage Current	6.0	V _I = V _{CC} or GND		— — —	— 0 0.1	— — —	— 0.1 ±0.1	— — —	— 0.1 ±1	— — —
I _{CC}	Quiescent Supply Current	6.0	V _I = V _{CC} or GND		— —	— —	1	— —	10	— —	20
AC ELECTRICAL CHARACTERISTICS (V _{CC} = 5V, T _A = 25°C, C _L = 15pF, Input t _r = t _f = 6ns)											

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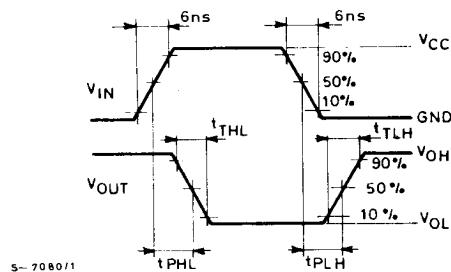
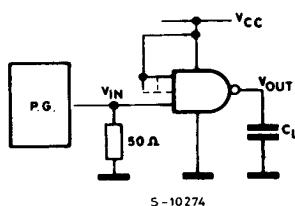
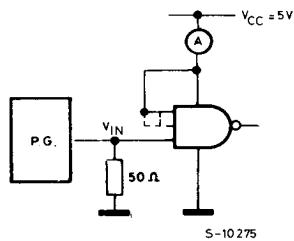
Symbol	Parameter	V _{CC}	Test Condition	54HC and 74HC			Unit
				Min.	Typ.	Max.	
t _{TLH} t _{THL}	Output Transition Time			—	4	8	ns
t _{PLH} t _{PHL}	Propagation Delay Time			—	17	27	ns

AC ELECTRICAL CHARACTERISTICS (C_L = 50pF, Input t_r = t_f = 6ns)

Symbol	Parameter	V _{CC}	Test Condition	T _A = 25°C 54HC and 74HC			Unit
				Min.	Typ.	Max.	
t _{TLH} t _{THL}	Output Transition Time	2.0 4.5 6.0		— — —	30 8 7	75 15 13	— — —
t _{PLH} t _{PHL}	Propagation Delay Time	2.0 4.5 6.0		— — —	80 20 17	150 30 26	— — —
C _{IN}	Input Capacitance			—	5	10	—
C _{PD (*)}	Power Dissipation Capacitance			—	34	— — —	— — —

Note (*) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the following equation. I_{CC(opr)} = C_{PD} × V_{CC} × f_{IN} + I_{CC}

SWITCHING CHARACTERISTICS TEST CIRCUIT

TEST CIRCUIT I_{CC} (Opr.)

INPUT WAVEFORM IS THE SAME AS THAT IN CASE OF SWITCHING CHARACTERISTICS TEST.