TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# **TC74HC133AP,TC74HC133AF**

### 13-Input NAND Gate

The TC74HC133A is a high speed CMOS 13-INPUT NAND GATE fabricated with silicon gate  $C^2MOS$  technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

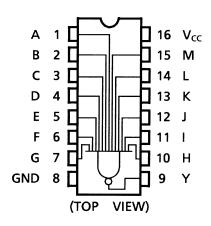
The internal circuit is composes of 7 stages, including a buffer output, which provide high noise immunity and stable output.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

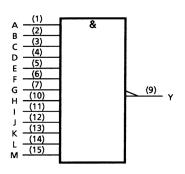
#### **Features**

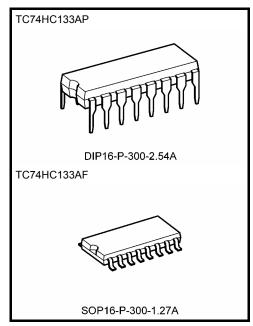
- High speed:  $t_{pd} = 13 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 1 \mu A \text{ (max)}$  at  $T_{a} = 25 \text{°C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance: |IOH| = IOL = 4 mA (min)
- Balanced propagation delays:  $t_{pLH} \simeq t_{pHL}$
- Wide operating voltage range:  $V_{CC}$  (opr) = 2 to 6 V
- Pin and function compatible with 74LS133

## **Pin Assignment**



#### **IEC Logic Symbol**





Weight

DIP16-P-300-2.54A : 1.00 g (typ.) SOP16-P-300-1.27A : 0.18 g (typ.)

#### **Truth Table**

Input	Output
All Inputs High	L
All Other Combinations	Н

# **Absolute Maximum Ratings (Note 1)**

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	–0.5 to 7	V
DC input voltage	V <sub>IN</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
DC output voltage	V <sub>OUT</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
Input diode current	I <sub>IK</sub>	±20	mA
Output diode current	lok	±20	mA
DC output current	lout	±25	mA
DC V <sub>CC</sub> /ground current	I <sub>CC</sub>	±50	mA
Power dissipation	P <sub>D</sub>	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	T <sub>stg</sub>	–65 to 150	°C

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 2: 500 mW in the range of Ta = -40 to  $65^{\circ}$ C. From Ta = 65 to  $85^{\circ}$ C a derating factor of -10 mW/°C shall be applied until 300 mW.

## **Operating Ranges (Note)**

Characteristics	Symbol	Rating	Unit
Supply voltage	V <sub>CC</sub>	2 to 6	٧
Input voltage	V <sub>IN</sub>	0 to V <sub>CC</sub>	V
Output voltage	V <sub>OUT</sub>	0 to V <sub>CC</sub>	V
Operating temperature	T <sub>opr</sub>	-40 to 85	°C
		0 to 1000 (V <sub>CC</sub> = 2.0 V)	
Input rise and fall time	t <sub>r</sub> , t <sub>f</sub>	0 to 500 (V <sub>CC</sub> = 4.5 V)	ns
		0 to 400 (V <sub>CC</sub> = 6.0 V)	

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either VCC or GND.



## **Electrical Characteristics**

#### **DC Characteristics**

Characteristics Symbol		Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
				V <sub>CC</sub> (V)	Min	Тур.	Max	Min	Max	
				2.0	1.50	_	_	1.50	_	
High-level input voltage	V <sub>IH</sub>		_	4.5	3.15	_	_	3.15	_	V
Ţ.				6.0	4.20	—	_	4.20	—	
				2.0	_	_	0.50	_	0.50	
Low-level input voltage	$V_{IL}$	_		4.5	_	_	1.35	_	1.35	V
Ţ.				6.0		—	1.80	_	1.80	
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>		2.0	1.9	2.0	_	1.9	_	
			$I_{OH} = -20 \mu A$	4.5	4.4	4.5	_	4.4	_	
High-level output voltage	V <sub>OH</sub>			6.0	5.9	6.0	_	5.9	—	V
			$I_{OH} = -4 \text{ mA}$	4.5	4.18	4.31	_	4.13	_	
			$I_{OH} = -5.2 \text{ mA}$	6.0	5.68	5.80		5.63	_	
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>		2.0		0.0	0.1	_	0.1	
			$I_{OL} = 20 \mu A$	4.5	_	0.0	0.1	_	0.1	
Low-level output voltage	V <sub>OL</sub>			6.0		0.0	0.1		0.1	V
			I <sub>OL</sub> = 4 mA	4.5		0.17	0.26	_	0.33	
			$I_{OL} = 5.2 \text{ mA}$	6.0	_	0.18	0.26	_	0.33	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0		_	±0.1		±1.0	μА
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	_	_	1.0		10.0	μА

# AC Characteristics (CL = 15 pF, $V_{CC}$ = 5 V, Ta = 25°C, input: $t_r$ = $t_f$ = 6 ns)

Characteristics	Symbol	Test Condition	Min	Тур.	Max	Unit
Output transition time	t <sub>TLH</sub>	_		4	8	ns
	$t_{THL}$					
Propagation delay time	t <sub>pLH</sub>			13	22	ns
	t <sub>pHL</sub>			10	22	113

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# AC Characteristics ( $C_L = 50 \text{ pF}$ , input: $t_r = t_f = 6 \text{ ns}$ )

Characteristics Symb	Symbol	Symbol Test Condition V <sub>CC</sub> (V)		Ta = 25°C			Ta = -40 to 85°C		Unit
	- <b>,</b>			Min	Тур.	Max	Min	Max	
	<b>4</b> —		2.0	_	25	75	_	95	
Output transition time t <sub>TLH</sub>		_	4.5	_	7	15	_	19	ns
	<sup>t</sup> THL		6.0	_	6	13	_	16	
time			2.0	_	42	130	_	165	
	t <sub>pLH</sub>	_	4.5	_	16	26	_	33	ns
	$t_{pHL}$		6.0	_	14	22	_	28	
Input capacitance	C <sub>IN</sub>	_		_	5	10	_	10	pF
Power dissipation capacitance	C <sub>PD</sub> (Note)	_		_	29	_	_	_	pF

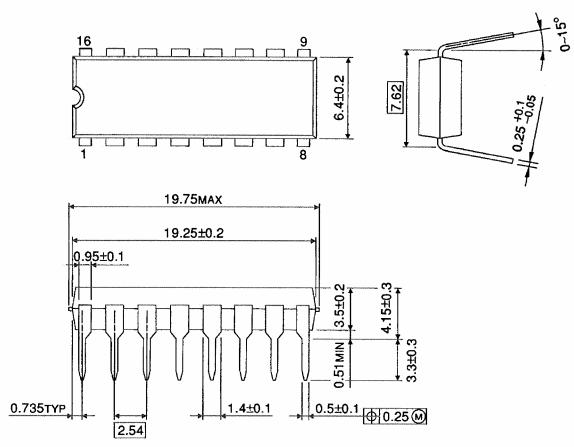
Note: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

$$I_{CC}$$
 (opr) =  $C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$ 

# **Package Dimensions**

DIP16-P-300-2.54A Unit: mm

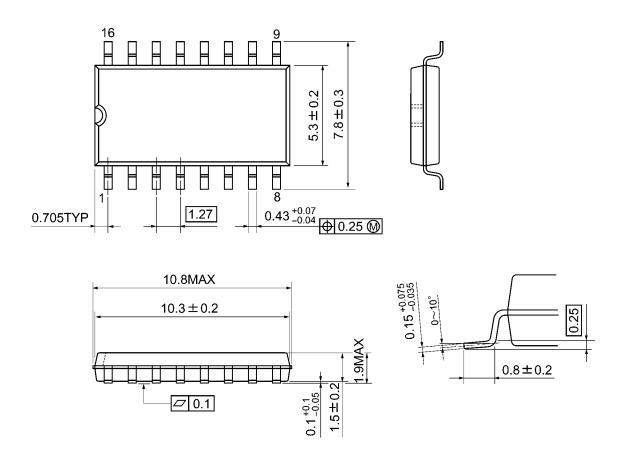


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Weight: 1.00 g (typ.)

# **Package Dimensions**

SOP16-P-300-1.27A Unit: mm



6

Weight: 0.18 g (typ.)

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20070701-EN GENERAL

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