

# MC74HC03A

## Quad 2-Input NAND Gate with Open-Drain Outputs High-Performance Silicon-Gate CMOS

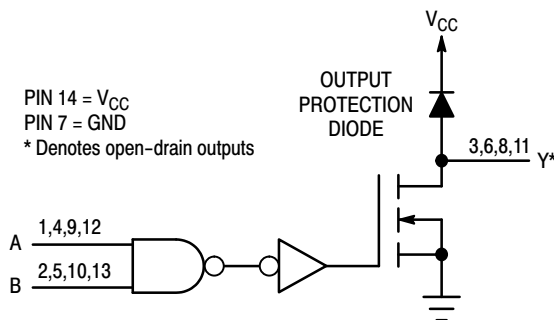
The MC74HC03A is identical in pinout to the LS03. The device inputs are compatible with Standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs.

The HC03A NAND gate has, as its outputs, a high-performance MOS N-Channel transistor. This NAND gate can, therefore, with a suitable pullup resistor, be used in wired-AND applications. Having the output characteristic curves given in this data sheet, this device can be used as an LED driver or in any other application that only requires a sinking current.

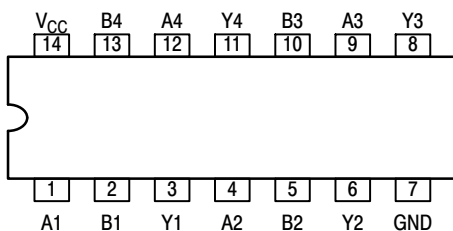
### Features

- Output Drive Capability: 10 LSTTL Loads With Suitable Pullup Resistor
- Outputs Directly Interface to CMOS, NMOS and TTL
- High Noise Immunity Characteristic of CMOS Devices
- Operating Voltage Range: 2.0 to 6.0 V
- Low Input Current: 1  $\mu$ A
- In Compliance With the JEDEC Standard No. 7 A Requirements
- Chip Complexity: 28 FETs or 7 Equivalent Gates
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### LOGIC DIAGRAM



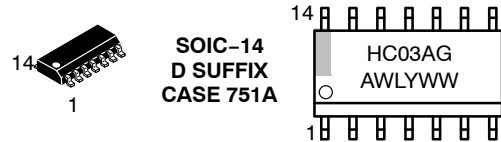
### Pinout: 14-Lead Packages (Top View)



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### MARKING DIAGRAMS



A = Assembly Location  
L, WL = Wafer Lot  
Y, YY = Year  
W, WW = Work Week  
G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

### FUNCTION TABLE

Inputs		Output
A	B	Y
L	L	Z
L	H	Z
H	L	Z
H	H	L

Z = High Impedance

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

# MC74HC03A

## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CC}$	DC Supply Voltage (Referenced to GND)	- 0.5 to + 7.0	V
$V_{in}$	DC Input Voltage (Referenced to GND)	- 0.5 to $V_{CC} + 0.5$	V
$V_{out}$	DC Output Voltage (Referenced to GND)	- 0.5 to $V_{CC} + 0.5$	V
$I_{in}$	DC Input Current, per Pin	$\pm 20$	mA
$I_{out}$	DC Output Current, per Pin	$\pm 25$	mA
$I_{CC}$	DC Supply Current, $V_{CC}$ and GND Pins	$\pm 50$	mA
$P_D$	Power Dissipation in Still Air SOIC Package <sup>†</sup> TSSOP Package <sup>†</sup>	500 450	mW
$T_{stg}$	Storage Temperature	-65 to + 150	°C
$T_L$	Lead Temperature, 1 mm from Case for 10 Seconds SOIC or TSSOP Package	260	°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$  should be constrained to the range  $GND \leq (V_{in} \text{ or } V_{out}) \leq V_{CC}$ . Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or  $V_{CC}$ ). Unused outputs must be left open.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

<sup>†</sup>Derating – SOIC Package: - 7 mW/°C from 65° to 125°C  
TSSOP Package: - 6.1 mW/°C from 65° to 125°C

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	DC Supply Voltage (Referenced to GND)	2.0	6.0	V
$V_{in}, V_{out}$	DC Input Voltage, Output Voltage (Referenced to GND)	0	$V_{CC}$	V
$T_A$	Operating Temperature, All Package Types	-55	+125	°C
$t_r, t_f$	Input Rise and Fall Time (Figure 1)	$V_{CC} = 2.0 \text{ V}$ $V_{CC} = 4.5 \text{ V}$ $V_{CC} = 6.0 \text{ V}$	0 1000 500 400	ns

## DESIGN GUIDE

Criteria	Value	Unit
Internal Gate Count*	7.0	ea
Internal Gate Propagation Delay	1.5	ns
Internal Gate Power Dissipation	5.0	$\mu\text{W}$
Speed Power Product	0.0075	pJ

\*Equivalent to a two-input NAND gate

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## DC CHARACTERISTICS (Voltages Referenced to GND)

Symbol	Parameter	Condition	V <sub>CC</sub> V	Guaranteed Limit			Unit
				-55 to 25°C	≤85°C	≤125°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage	V <sub>out</sub> = 0.1V or V <sub>CC</sub> - 0.1V  I <sub>out</sub>   ≤ 20μA	2.0	1.50	1.50	1.50	V
			3.0	2.10	2.10	2.10	
			4.5	3.15	3.15	3.15	
			6.0	4.20	4.20	4.20	
V <sub>IL</sub>	Maximum Low-Level Input Voltage	V <sub>out</sub> = 0.1V or V <sub>CC</sub> - 0.1V  I <sub>out</sub>   ≤ 20μA	2.0	0.50	0.50	0.50	V
			3.0	0.90	0.90	0.90	
			4.5	1.35	1.35	1.35	
			6.0	1.80	1.80	1.80	
V <sub>OL</sub>	Maximum Low-Level Output Voltage	V <sub>out</sub> = 0.1V or V <sub>CC</sub> - 0.1V  I <sub>out</sub>   ≤ 20μA	2.0	0.1	0.1	0.1	V
			4.5	0.1	0.1	0.1	
			6.0	0.1	0.1	0.1	
		V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 2.4mA  I <sub>out</sub>   ≤ 4.0mA  I <sub>out</sub>   ≤ 5.2mA	3.0	0.26	0.33	0.40	
			4.5	0.26	0.33	0.40	
			6.0	0.26	0.33	0.40	
I <sub>in</sub>	Maximum Input Leakage Current	V <sub>in</sub> = V <sub>CC</sub> or GND	6.0	±0.1	±1.0	±1.0	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current (per Package)	V <sub>in</sub> = V <sub>CC</sub> or GND I <sub>out</sub> = 0μA	6.0	1.0	10	40	μA
I <sub>OZ</sub>	Maximum Three-State Leakage Current	Output in High-Impedance State V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>out</sub> = V <sub>CC</sub> or GND	6.0	±0.5	±5.0	±10	μA

## AC CHARACTERISTICS (C<sub>L</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 6 ns)

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit
			-55 to 25°C	≤85°C	≤125°C	
t <sub>PLZ</sub> , t <sub>PZL</sub>	Maximum Propagation Delay, Input A or B to Output Y (Figures 1 and 2)	2.0	120	150	180	ns
		3.0	45	60	75	
		4.5	24	30	36	
		6.0	20	26	31	
t <sub>TLH</sub> , t <sub>THL</sub>	Maximum Output Transition Time, Any Output (Figures 1 and 2)	2.0	75	95	110	ns
		3.0	27	32	36	
		4.5	15	19	22	
		6.0	13	16	19	
C <sub>in</sub>	Maximum Input Capacitance		10	10	10	pF
C <sub>out</sub>	Maximum Three-State Output Capacitance (Output in High-Impedance State)		10	10	10	pF

C <sub>PD</sub>	Power Dissipation Capacitance (Per Buffer)*	Typical @ 25°C, V <sub>CC</sub> = 5.0 V, V <sub>EE</sub> = 0 V			pF
		8.0			

\* Used to determine the no-load dynamic power consumption: P<sub>D</sub> = C<sub>PD</sub> V<sub>CC</sub><sup>2</sup>f + I<sub>CC</sub> V<sub>CC</sub>.

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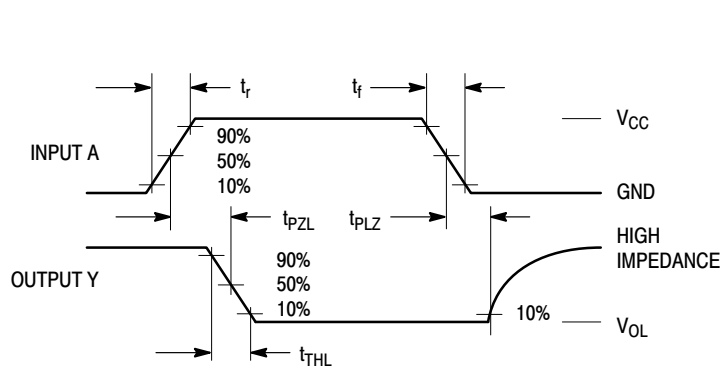
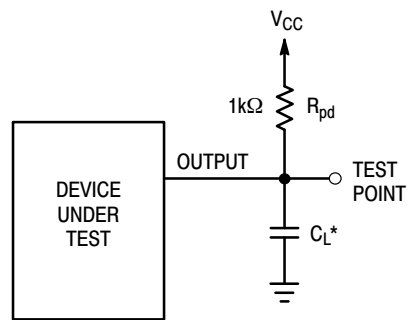
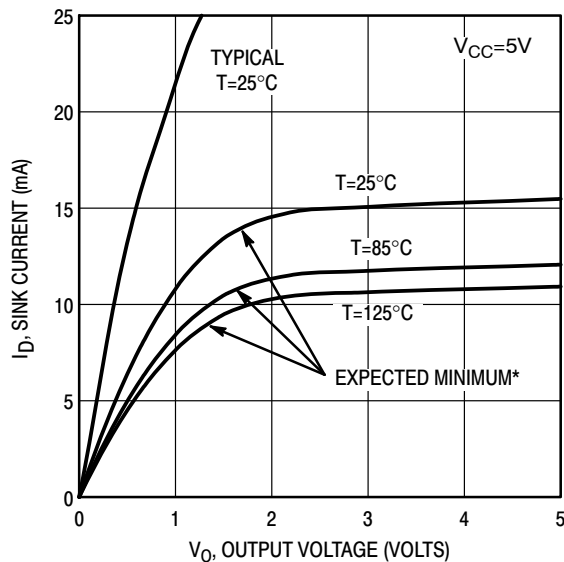


Figure 1. Switching Waveforms



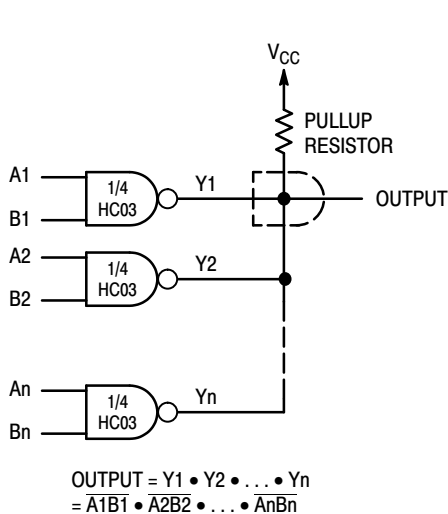
\*Includes all probe and jig capacitance

Figure 2. Test Circuit



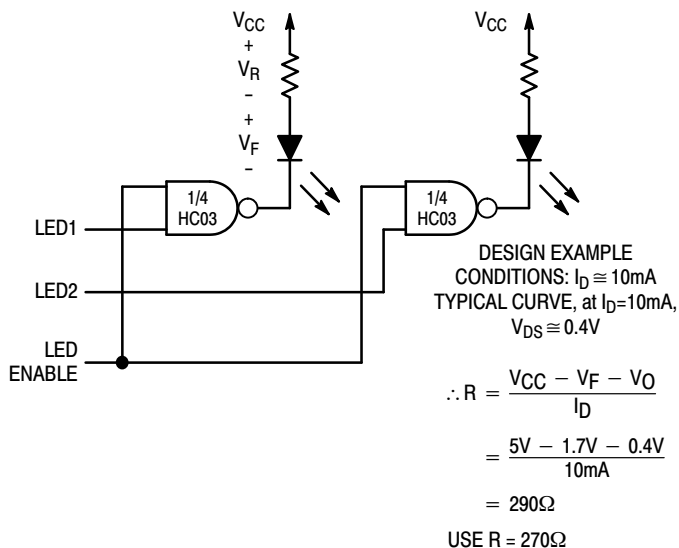
\*The expected minimum curves are not guarantees, but are design aids.

Figure 3. Open-Drain Output Characteristics



$$\begin{aligned} \text{OUTPUT} &= Y1 \cdot Y2 \cdot \dots \cdot Yn \\ &= \overline{A1B1} \cdot \overline{A2B2} \cdot \dots \cdot \overline{AnBn} \end{aligned}$$

Figure 4. Wired AND



DESIGN EXAMPLE  
CONDITIONS:  $I_D \cong 10\text{mA}$   
TYPICAL CURVE, at  $I_D=10\text{mA}$ ,  
 $V_{DS} \cong 0.4\text{V}$

$$\begin{aligned} \therefore R &= \frac{V_{CC} - V_F - V_O}{I_D} \\ &= \frac{5\text{V} - 1.7\text{V} - 0.4\text{V}}{10\text{mA}} \\ &= 290\Omega \end{aligned}$$

USE R = 270Ω

Figure 5. LED Driver With Blanking

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## ORDERING INFORMATION

Device	Package	Shipping†
MC74HC03ADG	SOIC-14 (Pb-Free)	55 Units / Rail
MC74HC03ADR2G	SOIC-14 (Pb-Free)	2500 / Tape & Reel
MC74HC03ADTR2G	TSSOP-14 (Pb-Free)	2500 / Tape & Reel
NLV74HC03ADG*	SOIC-14 (Pb-Free)	55 Units / Rail
NLV74HC03ADR2G*	SOIC-14 (Pb-Free)	2500 / Tape & Reel
NLV74HC03ADTR2G*	TSSOP-14 (Pb-Free)	2500 / Tape & Reel

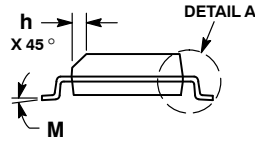
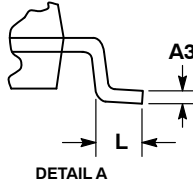
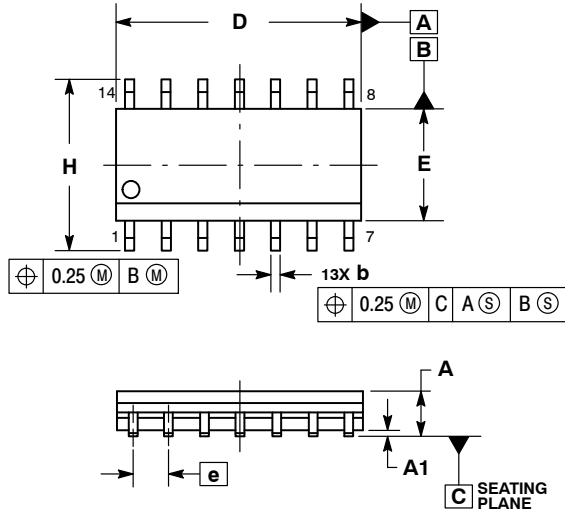
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable

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## PACKAGE DIMENSIONS

SOIC-14 NB  
CASE 751A-03  
ISSUE K

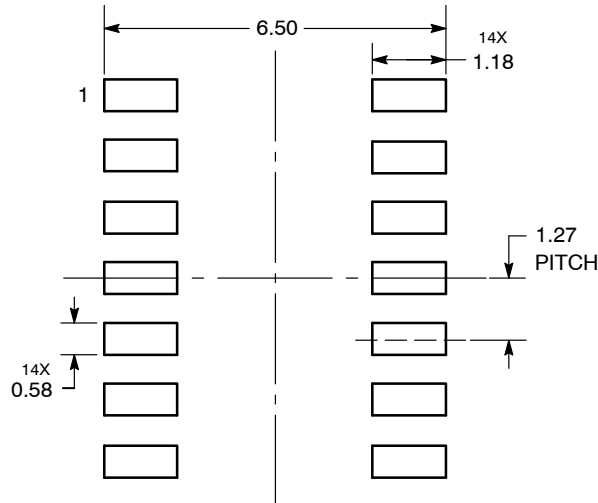


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0°	7°	0°	7°

### SOLDERING FOOTPRINT\*




DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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