

## High-Speed CMOS Logic Quad 2-Input NAND Gate with Open Drain

### Features

- Buffered Inputs
- Typical Propagation Delay: 8ns at  $V_{CC} = 5V$ ,  $C_L = 15pF$ ,  $T_A = 25^\circ C$
- Output Pull-up to 10V
- Fanout (Over Temperature Range)
  - Standard Outputs . . . . . 10 LSTTL Loads
  - Bus Driver Outputs . . . . . 15 LSTTL Loads
- Wide Operating Temperature Range . . .  $-55^\circ C$  to  $125^\circ C$
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- HC Types
  - 2V to 6V Operation
  - High Noise Immunity:  $N_{IL} = 30\%$ ,  $N_{IH} = 30\%$  of  $V_{CC}$  at  $V_{CC} = 5V$
- HCT Types
  - 4.5V to 5.5V Operation
  - Direct LSTTL Input Logic Compatibility,  $V_{IL} = 0.8V$  (Max),  $V_{IH} = 2V$  (Min)
  - CMOS Input Compatibility,  $I_I \leq 1\mu A$  at  $V_{OL}$ ,  $V_{OH}$

### Description

The 'HC03 and 'HCT03 logic gates utilize silicon gate CMOS technology to achieve operating speeds similar to LSTTL gates with the low power consumption of standard CMOS integrated circuits. All devices have the ability to drive 10 LSTTL loads. The HCT logic family is functionally as well as pin compatible with the standard LS logic family.

These open drain NAND gates can drive into resistive loads to output voltages as high as 10V. Minimum values of  $R_L$  required versus load voltage are shown in Figure 2.

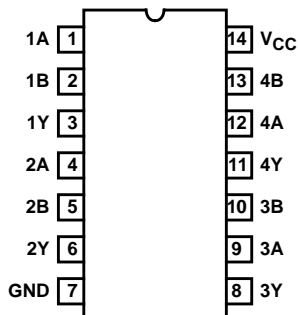
### Ordering Information

PART NUMBER	TEMP. RANGE ( $^\circ C$ )	PACKAGE
CD54HC03F3A	-55 to 125	14 Ld CERDIP
CD54HCT03F3A	-55 to 125	14 Ld CERDIP
CD74HC03E	-55 to 125	14 Ld PDIP
CD74HC03M	-55 to 125	14 Ld SOIC
CD74HC03MT	-55 to 125	14 Ld SOIC
CD74HC03M96	-55 to 125	14 Ld SOIC
CD74HCT03E	-55 to 125	14 Ld PDIP
CD74HCT03M	-55 to 125	14 Ld SOIC
CD74HCT03MT	-55 to 125	14 Ld SOIC
CD74HCT03M96	-55 to 125	14 Ld SOIC

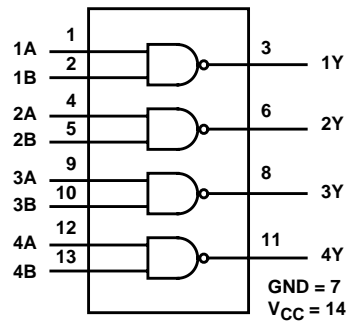
NOTE: When ordering, use the entire part number. The suffix 96 denotes tape and reel. The suffix T denotes a small-quantity reel of 250.

### Pinout

CD54HC03, CD54HCT03  
(CERDIP)  
CD74HC03, CD74HCT03  
(PDIP, SOIC)  
TOP VIEW



## Functional Diagram



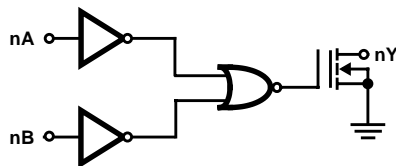
TRUTH TABLE

A	B	Y	
L	L	Z (Note 1)	H (Note 2)
H	L	Z (Note 1)	H (Note 2)
L	H	Z (Note 1)	H (Note 2)
H	H	L	L

NOTES:

1. Without pull-up (high impedance)
2. Requires pull-up ( $R_L$  to  $V_L$ )

## Logic Symbol



# CD54HC03, CD74HC03, CD54HCT, CD74HCT03

## Absolute Maximum Ratings

DC Supply Voltage, $V_{CC}$	-0.5V to 7V
DC Input Diode Current, $I_{IK}$	
For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$	$\pm 20mA$
DC Output Diode Current, $I_{OK}$	
For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$	$\pm 20mA$
DC Output Source or Sink Current per Output Pin, $I_O$	
For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$	$\pm 25mA$
DC Drain Current, per Output, $I_O$	
For $-0.5V < V_O$	$-25mA$
DC $V_{CC}$ or Ground Current, $I_{CC}$ or $I_{GND}$	$\pm 50mA$

## Thermal Information

Thermal Resistance (Typical, Note 3)	$\theta_{JA}$ ( $^{\circ}C/W$ )
E (PDIP) Package	80
M (SOIC) Package	86
Maximum Junction Temperature (Hermetic Package or Die)	175 $^{\circ}C$
Maximum Junction Temperature (Plastic Package)	150 $^{\circ}C$
Maximum Storage Temperature Range	-65 $^{\circ}C$ to 150 $^{\circ}C$
Maximum Lead Temperature (Soldering 10s)	300 $^{\circ}C$
(SOIC - Lead Tips Only)	

## Operating Conditions

Temperature Range ( $T_A$ )	-55 $^{\circ}C$ to 125 $^{\circ}C$
Supply Voltage Range, $V_{CC}$	
HC Types	.2V to 6V
HCT Types	.4.5V to 5.5V
DC Input or Output Voltage, $V_I$ , $V_O$	0V to $V_{CC}$
Input Rise and Fall Time	
2V	1000ns (Max)
4.5V	500ns (Max)
6V	400ns (Max)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

- The package thermal impedance is calculated in accordance with JESD 51-7.

## DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		V <sub>CC</sub> (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		V <sub>I</sub> (V)	I <sub>O</sub> (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
HC TYPES												
High Level Input Voltage	V <sub>IH</sub>	-	-	2	1.5	-	-	1.5	-	1.5	-	V
				4.5	3.15	-	-	3.15	-	3.15	-	V
				6	4.2	-	-	4.2	-	4.2	-	V
Low Level Input Voltage	V <sub>IL</sub>	-	-	2	-	-	0.5	-	0.5	-	0.5	V
				4.5	-	-	1.35	-	1.35	-	1.35	V
				6	-	-	1.8	-	1.8	-	1.8	V
Low Level Output Voltage CMOS Loads	V <sub>OL</sub>	V <sub>IH</sub> or V <sub>IL</sub>	0.02	2	-	-	0.1	-	0.1	-	0.1	V
			0.02	4.5	-	-	0.1	-	0.1	-	0.1	V
			0.02	6	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads			-	-	-	-	-	-	-	-	-	V
			4	4.5	-	-	0.26	-	0.33	-	0.4	V
			5.2	6	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	I <sub>I</sub>	V <sub>CC</sub> or GND	-	6	-	-	±0.1	-	±1	-	±1	μA
Quiescent Device Current	I <sub>CC</sub>	V <sub>CC</sub> or GND	0	6	-	-	2	-	20	-	40	μA
HCT TYPES												
High Level Input Voltage	V <sub>IH</sub>	-	-	4.5 to 5.5	2	-	-	2	-	2	-	V
Low Level Input Voltage	V <sub>IL</sub>	-	-	4.5 to 5.5	-	-	0.8	-	0.8	-	0.8	V

**CD54HC03, CD74HC03, CD54HCT03, CD74HCT03**

**DC Electrical Specifications (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS		$V_{CC}$ (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		$V_I$ (V)	$I_O$ (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Low Level Output Voltage CMOS Loads	$V_{OL}$	$V_{IH}$ or $V_{IL}$	0.02	4.5	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads			4	4.5	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	$I_I$	$V_{CC}$ and GND	-	5.5	-		$\pm 0.1$	-	$\pm 1$	-	$\pm 1$	$\mu A$
Quiescent Device Current	$I_{CC}$	$V_{CC}$ or GND	0	5.5	-	-	2	-	20	-	40	$\mu A$
Additional Quiescent Device Current Per Input Pin: 1 Unit Load	$\Delta I_{CC}$ (Note 4)	$V_{CC} - 2.1$	-	4.5 to 5.5	-	100	360	-	450	-	490	$\mu A$

NOTE:

4. For dual-supply systems theoretical worst case ( $V_I = 2.4V$ ,  $V_{CC} = 5.5V$ ) specification is 1.8mA.

**HCT Input Loading Table**

INPUT	UNIT LOADS
nA, nB	1

NOTE: Unit Load is  $\Delta I_{CC}$  limit specified in DC Electrical Specifications table, e.g., 360 $\mu A$  max at 25°C.

**Switching Specifications** Input  $t_r$ ,  $t_f = 6ns$

PARAMETER	SYMBOL	TEST CONDITIONS	V <sub>CC</sub> (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
HC TYPES											
Propagation Delay, Input to Output (Figure 1)	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 50pF	2	-	-	100	-	125	-	150	ns
			4.5	-	-	20	-	25	-	30	ns
			6	-	-	17	-	21	-	26	ns
Propagation Delay, Data Input to Output Y	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 15pF	5	-	8	-	-	-	-	-	ns
Transition Times (Figure 1)	t <sub>TLH</sub> , t <sub>THL</sub>	C <sub>L</sub> = 50pF	2	-	-	75	-	95	18	110	ns
			4.5	-	-	15	-	19	-	22	ns
			6	-	-	13	-	16	-	19	ns
Input Capacitance	C <sub>I</sub>	-	-	-	-	10	-	10	-	10	pF
Power Dissipation Capacitance (Notes 5, 6)	C <sub>PD</sub>	-	5	-	6.4	-	-	-	-	-	pF
HCT TYPES											
Propagation Delay, Input to Output (Figure 1)	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 50pF	4.5	-	-	24	-	30	-	36	ns
Propagation Delay, Data Input to Output Y	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 15pF	5	-	9	-	-	-	-	-	ns
Transition Times (Figure 1)	t <sub>TLH</sub> , t <sub>THL</sub>	C <sub>L</sub> = 50pF	4.5	-	-	15	-	19	-	22	ns
Input Capacitance	C <sub>I</sub>	-	-	-	-	10	-	10	-	10	pF

# CD54HC03, CD74HC03, CD54HCT03, CD74HCT03

## Switching Specifications Input $t_r, t_f = 6\text{ns}$ (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	$V_{CC}$ (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Power Dissipation Capacitance (Notes 5, 6)	$C_{PD}$	-	5	-	9	-	-	-	-	-	pF

### NOTES:

- $C_{PD}$  is used to determine the dynamic power consumption, per gate.
- $P_D = C_{PD} V_{CC}^2 f_i + \sum (C_L V_{CC}^2 f_o) + \sum (V_L^2/R_L)$  (Duty Factor "Low")  
where  $f_i$  = input frequency,  $f_o$  = output frequency,  $C_L$  = output load capacitance,  $V_{CC}$  = supply voltage, Duty Factor "Low" = percent of time output is "low",  $V_L$  = output voltage,  $R_L$  = pull-up resistor.

## Test Circuits and Waveforms

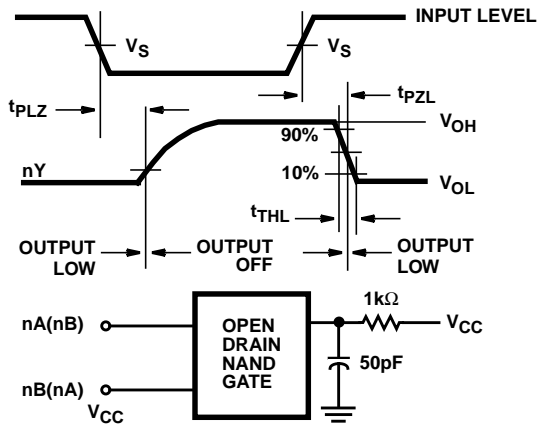


FIGURE 1. TRANSITION TIMES, PROPAGATION DELAY TIMES, AND TEST CIRCUIT

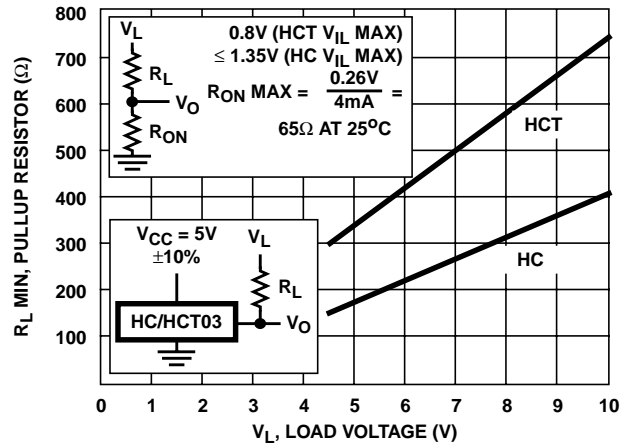


FIGURE 2. MINIMUM RESISTIVE LOAD vs LOAD VOLTAGE

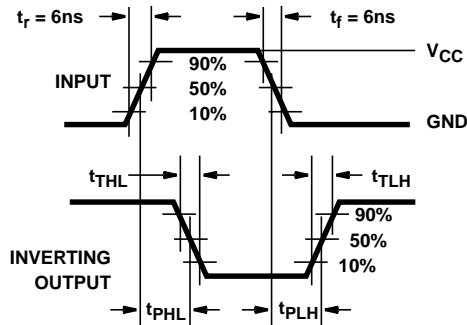


FIGURE 3. HC AND HCU TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

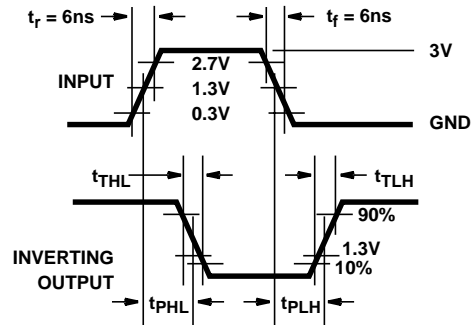


FIGURE 4. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
CD54HC03F	ACTIVE	CDIP	J	14	1	TBD	Call TI	N / A for Pkg Type
CD54HC03F3A	ACTIVE	CDIP	J	14	1	TBD	Call TI	N / A for Pkg Type
CD54HCT03F3A	ACTIVE	CDIP	J	14	1	TBD	Call TI	N / A for Pkg Type
CD74HC03E	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD74HC03EE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD74HC03M	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC03M96	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC03M96E4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC03ME4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC03MT	ACTIVE	SOIC	D	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC03MTE4	ACTIVE	SOIC	D	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT03E	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD74HCT03EE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD74HCT03M	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT03M96	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT03M96E4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT03ME4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT03MT	ACTIVE	SOIC	D	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT03MTE4	ACTIVE	SOIC	D	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS

compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package is hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.



N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



4040049/E 12/2002

NOTES:

- A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).  
 The 20 pin end lead shoulder width is a vendor option, either half or full width.

## D (R-PDSO-G14)

## PLASTIC SMALL-OUTLINE PACKAGE



4040047-3/F 07/2004

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DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
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