

# Quad 2-Input AND Gate

## MC74VHCT08A

The MC74VHCT08A is an advanced high speed CMOS 2-input AND gate fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The VHCT inputs are compatible with TTL levels. This device can be used as a level converter for interfacing 3.3 V to 5.0 V, because it has full 5.0 V CMOS level output swings.

The VHCT08A input structures provide protection when voltages between 0 V and 5.5 V are applied, regardless of the supply voltage. The output structures also provide protection when  $V_{CC} = 0$  V. These input and output structures help prevent device destruction caused by supply voltage – input/output voltage mismatch, battery backup, hot insertion, etc.

The internal circuit is composed of three stages, including a buffer output which provides high noise immunity and stable output. The inputs tolerate voltages up to 7.0 V, allowing the interface of 5.0 V systems to 3.0 V systems.

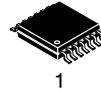
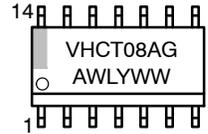
### Features

- High Speed:  $t_{PD} = 4.3$  ns (Typ) at  $V_{CC} = 5$  V
- Low Power Dissipation:  $I_{CC} = 2$   $\mu$ A (Max) at  $T_A = 25^\circ$ C
- TTL-Compatible Inputs:  $V_{IL} = 0.8$  V;  $V_{IH} = 2.0$  V
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2 V to 5.5 V Operating Range
- Low Noise:  $V_{OLP} = 0.8$  V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance: Human Body Model; > 2000 V, Machine Model; > 200 V
- Chip Complexity: 24 FETs or 6 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 and are RoHS Compliant

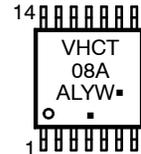
### MARKING DIAGRAMS



SOIC-14  
D SUFFIX  
CASE 751A



TSSOP-14  
DT SUFFIX  
CASE 948G



A = Assembly Location  
WL, L = Wafer Lot  
Y, YY = Year  
WW, W = Work Week  
G or ■ = Pb-Free Package  
(Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

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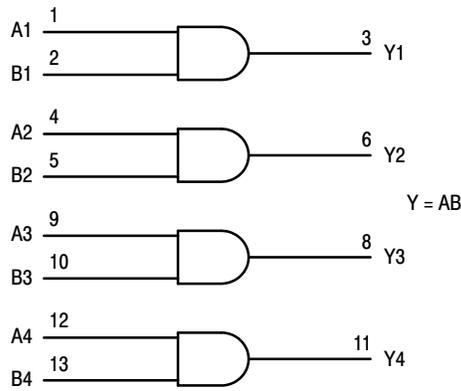


Figure 1. Logic Diagram

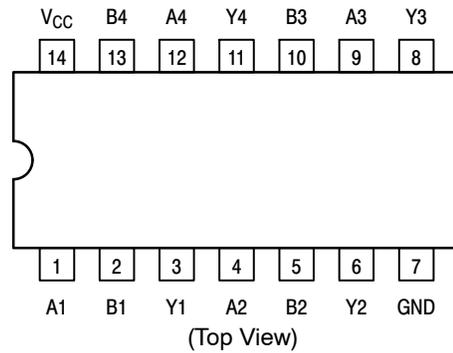


Figure 2. Pinout: 14-Lead Packages

## FUNCTION TABLE

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

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
DC Supply Voltage	$V_{CC}$	-0.5 to +7.0	V
DC Input Voltage	$V_{in}$	-0.5 to +7.0	V
DC Output Voltage	$V_{out}$	-0.5 to $V_{CC} + 0.5$	V
Input Diode Current	$I_{IK}$	-20	mA
Output Diode Current	$I_{OK}$	$\pm 20$	mA
DC Output Current, per Pin	$I_{out}$	$\pm 25$	mA
DC Supply Current, $V_{CC}$ and GND Pins	$I_{CC}$	$\pm 50$	mA
Power Dissipation in Still Air, SOIC Packages† TSSOP Package†	$P_D$	500 450	mW
Storage Temperature	$T_{stg}$	-65 to +150	°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 those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Max	Unit
DC Supply Voltage	$V_{CC}$	2.0	5.5	V
DC Input Voltage	$V_{in}$	0	5.5	V
DC Output Voltage	$V_{out}$	0	$V_{CC}$	V
Operating Temperature	$T_A$	-40	+ 125	°C
Input Rise and Fall Time $V_{CC} = 5.0 \text{ V} \pm 0.5 \text{ V}$	$t_r, t_f$	0	20	ns/V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

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## DC ELECTRICAL CHARACTERISTICS

Parameter	Test Conditions	Symbol	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> ≤ 85°C		T <sub>A</sub> ≤ 125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
Minimum High-Level Input Voltage		V <sub>IH</sub>	3.0 4.5 5.5	1.2 2.0 2.0			1.2 2.0 2.0		1.2 2.0 2.0		V
Maximum Low-Level Input Voltage		V <sub>IL</sub>	3.0 4.5 5.5			0.53 0.8 0.8		0.53 0.8 0.8		0.53 0.8 0.8	V
Minimum High-Level Output Voltage V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = -50 μA	V <sub>OH</sub>	3.0 4.5	2.9 4.4	3.0 4.5		2.9 4.4		2.9 4.4		V
	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = -4 mA I <sub>OH</sub> = -8 mA		3.0 4.5	2.58 3.94			2.48 3.80		2.34 3.66		
Maximum Low-Level Output Voltage V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OL</sub> = 50 μA	V <sub>OL</sub>	3.0 4.5		0.0 0.0	0.1 0.1		0.1 0.1		0.1 0.1	V
	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OL</sub> = 4 mA I <sub>OL</sub> = 8 mA		3.0 4.5			0.36 0.36		0.44 0.44		0.52 0.52	
Maximum Input Leakage Current	V <sub>IN</sub> = 5.5 V or GND	I <sub>IN</sub>	0 to 5.5			±0.1		±1.0		±1.0	μA
Maximum Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	I <sub>CC</sub>	5.5			2.0		20		40	μA
Quiescent Supply Current	Input: V <sub>IN</sub> = 3.4 V	I <sub>CC(T)</sub>	5.5			1.35		1.50		1.65	mA
Output Leakage Current	V <sub>OUT</sub> = 5.5 V	I <sub>OPD</sub>	0.0			0.5		5.0		10	μA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## AC ELECTRICAL CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0ns)

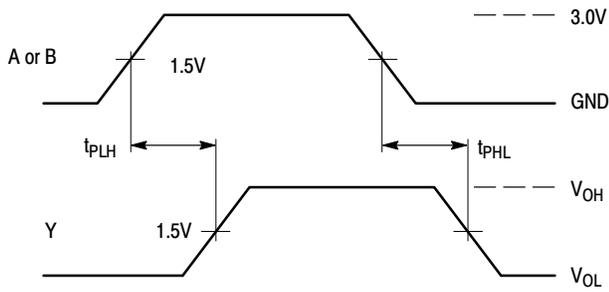
Characteristic	Test Conditions	Symbol	T <sub>A</sub> = 25°C			T <sub>A</sub> ≤ 85°C		T <sub>A</sub> ≤ 125°C		Unit
			Min	Typ	Max	Min	Max	Max	Max	
Maximum Propagation Delay, Input A or B to Y	V <sub>CC</sub> = 3.0 ± 0.3V C <sub>L</sub> = 15 pF C <sub>L</sub> = 50 pF	t <sub>PLH</sub> , t <sub>PHL</sub>		6.2 8.7	8.8 12.3		10.5 14.0		14.0 17.5	ns
	V <sub>CC</sub> = 5.0 ± 0.5V C <sub>L</sub> = 15 pF C <sub>L</sub> = 50 pF			4.3 5.8	5.9 7.9		7.0 9.0		9.0 11.0	
Maximum Input Capacitance		C <sub>in</sub>		4	10		10		10	pF
Power Dissipation Capacitance (Note 1)		C <sub>PD</sub>	Typical @ 25°C, V <sub>CC</sub> = 5.0V							
			20							pF

1. 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<sub>CC(OPR)</sub> = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>in</sub> + I<sub>CC</sub>/4 (per gate). C<sub>PD</sub> is 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<sub>in</sub> + I<sub>CC</sub> • V<sub>CC</sub> • 7

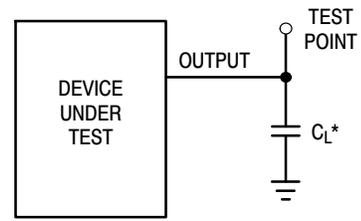
## NOISE CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0 ns, C<sub>L</sub> = 50pF, V<sub>CC</sub> = 5.0 V)

Characteristic	Symbol	T <sub>A</sub> = 25°C		Unit
		Typ	Max	
Quiet Output Maximum Dynamic V <sub>OL</sub>	V <sub>OLP</sub>	0.3	0.8	V
Quiet Output Minimum Dynamic V <sub>OL</sub>	V <sub>OLV</sub>	-0.3	-0.8	V
Minimum High Level Dynamic Input Voltage	V <sub>IHD</sub>		3.5	V
Maximum Low Level Dynamic Input Voltage	V <sub>ILD</sub>		1.5	V

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**Figure 3. Switching Waveforms**



\*Includes all probe and jig capacitance

**Figure 4. Test Circuit**

## ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
MC74VHCT08ADR2G	SOIC-14 (Pb-Free)	2500 Units / Tape & Reel
MC74VHCT08ADTR2G	TSSOP-14 (Pb-Free)	2500 Units / Tape & Reel
NLV74VHCT08ADTR2G*	TSSOP-14 (Pb-Free)	2500 Units / Tape & Reel

<sup>†</sup>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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