# **Quad 2-Input AND Gate**

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:  $t_{PD} = 4.3 \text{ ns}$  (Typ) at  $V_{CC} = 5 \text{ V}$
- Low Power Dissipation:  $I_{CC} = 2 \mu A$  (Max) at  $T_A = 25^{\circ}C$
- TTL-Compatible Inputs:  $V_{IL} = 0.8 \text{ V}$ ;  $V_{IH} = 2.0 \text{ V}$
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2 V to 5.5 V Operating Range
- Low Noise:  $V_{OLP} = 0.8 \text{ V (Max)}$
- 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
- Pb-Free Packages are Available\*



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MARKING DIAGRAMS



SOIC-14 D SUFFIX CASE 751A



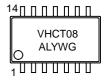


TSSOP-14 DT SUFFIX CASE 948G





SOEIAJ-14 M SUFFIX CASE 965



A = Assembly Location

VL, L = Wafer Lot
/, 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.

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

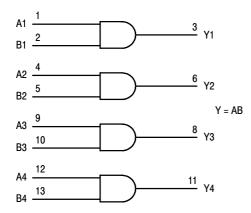


Figure 1. Logic Diagram

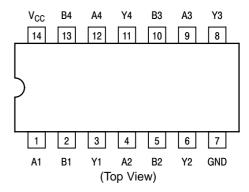


Figure 2. Pinout: 14-Lead Packages

#### **FUNCTION TABLE**

Inp	uts	Output
Α	В	Y
Г	L	L
4	Н	L
H	L	L
Н	Н	Н

## **MAXIMUM RATINGS\***

		333	30
MAXIMUM RATINGS*		1 3 0	JIN.
Rating	Symbol	<b>V</b> alue	Unit
DC Supply Voltage	V <sub>CC</sub>	-0.5 to +7.0	V
DC Input Voltage	V <sub>in</sub>	-0.5 to +7.0	V
DC Output Voltage	Vout	-0.5 to V <sub>CC</sub> +0.5	V
Input Diode Current	l <sub>IK</sub>	-20	mA
Output Diode Current	I <sub>OK</sub>	±20	mA
DC Output Current, per Pin	I <sub>out</sub>	±25	mA
DC Supply Current, V <sub>CC</sub> and GND Pins	I <sub>CC</sub>	±50	mA
Power Dissipation in Still Air, SOIC Packages† TSSOP Package†	P <sub>D</sub>	500 450	mW
Storage Temperature	T <sub>stg</sub>	-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, Vin and Vout should be constrained to the range GND  $\leq$  (V<sub>in</sub> or V<sub>out</sub>)  $\leq$  V<sub>CC</sub>.

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.

Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute-maximum-rated conditions is not implied.

†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 <sub>CC</sub>	4.5	5.5	V
DC Input Voltage	V <sub>in</sub>	0	5.5	V
DC Output Voltage	V <sub>out</sub>	0	V <sub>CC</sub>	V
Operating Temperature	T <sub>A</sub>	-40	+ 85	°C
Input Rise and Fall Time $V_{CC}$ = 5.0 V ±0.5 V	t <sub>r</sub> , t <sub>f</sub>	0	20	ns/V

# DC ELECTRICAL CHARACTERISTICS

			V <sub>CC</sub>	Т	A = 25°	C.	T <sub>A</sub> ≤	85°C	<b>T</b> <sub>A</sub> ≤ '	125°C	
Parameter	Test Conditions	Symbol	(V)	Min	Тур	Max	Min	Max	Min	Max	Unit
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
	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $I_{OH} = -50  \mu\text{A}$	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
	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $I_{OH} = -4 \text{ mA}$ $I_{OH} = -8 \text{ mA}$		3.0 4.5	2.58 3.94			2.48 3.80		2.34 3.66		
Maximum Low-Level Output Voltage $V_{IN} = V_{IH}$ or $V_{IL}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $I_{OL} = 50  \mu\text{A}$	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
	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $I_{OL} = 4 \text{ mA}$ $I_{OL} = 8 \text{ mA}$		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		3	±0.1		±1.0		±1.0	μΑ
Maximum Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND	I <sub>CC</sub>	5.5	<b>3</b> 3	4	2.0		20		40	μА
Quiescent Supply Current	Input: V <sub>IN</sub> = 3.4 V	I <sub>CCT</sub>	5.5	13		1.35		1.50		1.65	mA
Output Leakage Current	V <sub>OUT</sub> = 5.5 V	I <sub>OPD</sub>	<b>0</b> .0		100	0.5		5.0		10	μΑ

# AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns)

			Т	A = 25°	С	T <sub>A</sub> ≤	85°C	<b>T</b> <sub>A</sub> ≤ 1	125°C	
Characteristic	Test Conditions	Symbol	Min	Тур	Max	Min	Max	Max	Max	Unit
Maximum Propagation Delay, Input A or B to Y	$V_{CC} = 3.0 \pm 0.3 V$ $C_L = 15 \text{ pF}$ $C_L = 50 \text{ pF}$	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
	$V_{CC} = 5.0 \pm 0.5 V C_L = 15 \text{ pF}$ $C_L = 50 \text{ pF}$			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
		C <sub>PD</sub>	Typical @ 25°C, V <sub>CC</sub> = 5.0V							
Power Dissipation Capacitance	e (Note 1)					20				pF

<sup>1.</sup> 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:  $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}/4$  (per gate). C<sub>PD</sub> is used to determine the no–load dynamic power consumption;  $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}.7$ 

# **NOISE CHARACTERISTICS** (Input $t_r = t_f = 3.0 \text{ ns}$ , $C_L = 50 \text{pF}$ , $V_{CC} = 5.0 \text{ V}$ )

		T <sub>A</sub>	= 25°C	
Characteristic	Symbol	Тур	Max	Unit
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

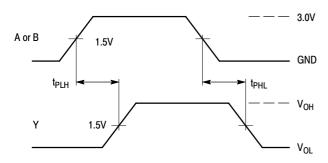
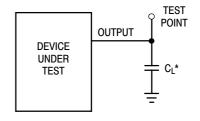


Figure 3. Switching Waveforms



\*Includes all probe and jig capacitance

Figure 4. Test Circuit

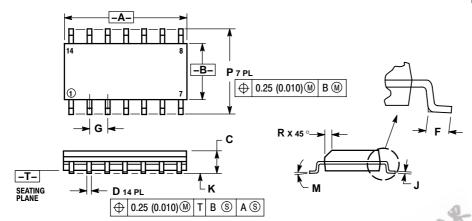
# **ORDERING INFORMATION**

Device	•	Package	Shipping <sup>†</sup>
MC74VHCT08ADR2		SOIC-14	
MC74VHCT08ADR2G		SOIC-14 (Pb-Free)	2500 Units / Tape & Reel
MC74VHCT08ADTR2		TSSOP-14*	2500 Unite / Tana & Dayl
MC74VHCT08ADTR2G		TSSOP-14*	2500 Units / Tape &Reel
MC74VHCT08AM		SOEIAJ-14	
MC74VHCT08AMG		SOEIAJ-14 (Pb-Free)	50 Units / Rail
MC74VHCT08AMEL		SOEIAJ-14	
MC74VHCT08AMELG		SOEIAJ-14 (Pb-Free)	2000 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.
\*These packages are inherently Pb-Free.

#### **PACKAGE DIMENSIONS**

#### SOIC-14 **D SUFFIX** CASE 751A-03 **ISSUE G**



- NOTES:
  1. DIMENSIONING AND TOLERANCING PER ANSI
- 1. DIMENSIONING AND TOLERANCING PER AIT Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 (0.006)

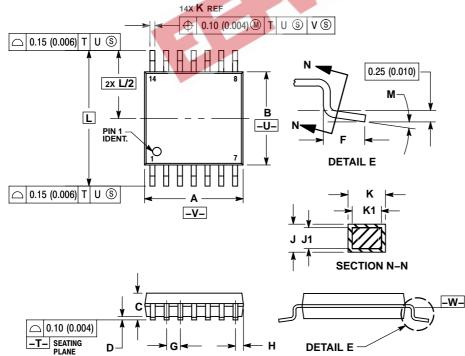
MAXIMUM MATERIAL CONDITION.

- PER SIDE.
- PER SIDE.

  5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT

	MILLIN	IETERS	INC	HES
DIM	MIN	MAX	MIN	MAX
Α	8.55	8.75	0.337	0.344
В	3.80	4.00	0.150	0.157
С	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27	BSC	0.050	BSC
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0 °	7°	0 °	7°
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

# TSSOP-14 CASE 948G-01 **ISSUE** A



#### NOTES:

- JIES:

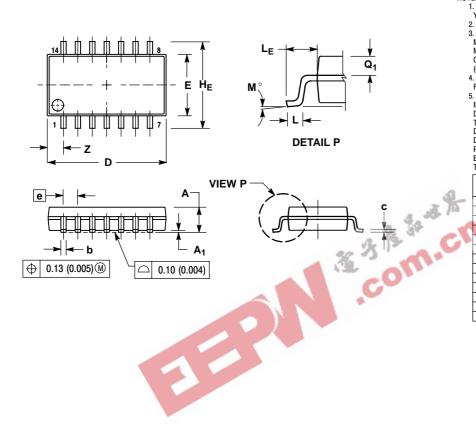
  1. DIMENSIONING AND TOLERANCING PER
  ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A DOES NOT INCLUDE MOLD
  FLASH, PROTRUSIONS OR GATE BURRS.
  MOLD FLASH OR GATE BURRS SHALL NOT
- MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.

  4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
- 5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K
  DIMENSION AT MAXIMUM MATERIAL
- CONDITION.
  6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
  7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE –W–.

	MILLIN	IETERS	INC	HES
DIM	MIN	MAX	MIN	MAX
Α	4.90	5.10	0.193	0.200
В	4.30	4.50	0.169	0.177
С		1.20		0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65	BSC	0.026	BSC
Н	0.50	0.60	0.020	0.024
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
Г	6.40	BSC	0.252	BSC
М	0 °	00	0 0	00

#### PACKAGE DIMENSIONS

SOEIAJ-14 CASE 965-01 ISSUE A



#### NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI
  Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSIONS D AND E DO NOT INCLUDE
   MOLD FLASH OR PROTRUSIONS AND ARE
   MEASURED AT THE PARTING LINE. MOLD FLASH
   OR PROTRUSIONS SHALL NOT EXCEED 0.15
   (0.006) PER SIDE.
- TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
- 5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.98 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

	MILLIN	IETERS	INC	HES
DIM	MIN	MAX	MIN	MAX
Α	-	2.05	-	0.081
A <sub>1</sub>	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
C	0.10	0.20	0.004	0.008
D	9.90	10.50	0.390	0.413
E	5.10	5.45	0.201	0.215
е	1.27	BSC	0.050	BSC
HE	7.40	8.20	0.291	0.323
0.50	0.50	0.85	0.020	0.033
F	1.10	1.50	0.043	0.059
M	0 °	10 °	0°	10 °
$Q_1$	0.70	0.90	0.028	0.035
Z		1.42		0.056

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