

2-input AND Gate with Open Drain Output

MC74VHC1G09E

The MC74VHC1G09E is an advanced high speed CMOS 2-input AND gate with open drain output fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The internal circuit is composed of three stages, including an open drain output which provides the capability to set output switching level. This allows the MC74VHC1G09E to be used to interface 5 V circuits to circuits of any voltage between V_{CC} and 5.5 V using an external resistor and power supply.

The MC74VHC1G09E input structure provides protection when voltages up to 5.5 V are applied, regardless of the supply voltage.

Features

- High Speed: $t_{PD} = 4.3$ ns (Typ) at $V_{CC} = 5$ V
- Low Internal Power Dissipation: $I_{CC} = 1$ μ A (Max) at $T_A = 25^\circ\text{C}$
- Power Down Protection Provided on Inputs
- Pin and Function Compatible with Other Standard Logic Families
- Chip Complexity: FETs = 62; Equivalent Gates = 16
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

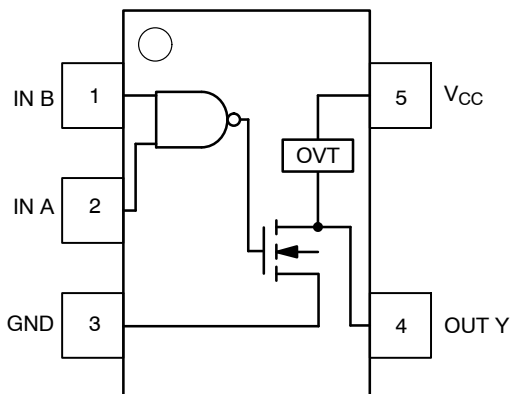


Figure 1. Pinout (Top View)

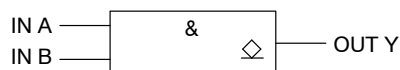
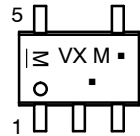


Figure 2. Logic Symbol

MARKING DIAGRAMS



SC-88A / SOT-353 / SC-70
DF SUFFIX
CASE 419A



VX = Device Code
M = Date Code*
▪ = Pb-Free Package

(Note: Microdot may be in either location)

* Date Code orientation and/or position may vary depending upon manufacturing location.

PIN ASSIGNMENT

Pin	Function
1	IN B
2	IN A
3	GND
4	OUT Y
5	V_{CC}

FUNCTION TABLE

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

ORDERING INFORMATION

See detailed ordering and shipping information on page 4 of this data sheet.

MC74VHC1G09E

MAXIMUM RATINGS

Symbol	Characteristics	Value	Unit
V _{CC}	DC Supply Voltage	−0.5 to +6.5	V
V _{IN}	DC Input Voltage	−0.5 to +6.5	V
V _{OUT}	DC Output Voltage	−0.5 to +6.5	V
I _{IK}	Input Diode Current	−20	mA
I _{OK}	Output Diode Current	+20	mA
I _{OUT}	DC Output Current, per Pin	+25	mA
I _{CC}	DC Supply Current, V _{CC} and GND	+50	mA
P _D	Power dissipation in still air	200	mW
θ _{JA}	Thermal resistance	333	°C/W
T _L	Lead temperature, 1 mm from case for 10 s	260	°C
T _J	Junction temperature under bias	+150	°C
T _{stg}	Storage temperature	−65 to +150	°C
MSL	Moisture Sensitivity	Level 1	
F _R	Flammability Rating	Oxygen Index: 28 to 34 UL 94 V-0 @ 0.125 in	
V _{ESD}	ESD Withstand Voltage	Human Body Model (Note 1) Charged Device Model (Note 2)	4000 1000
I _{Latchup}	Latchup Performance	Above V _{CC} and Below GND at 125 °C (Note 3)	±100

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.

1. Tested to EIA/JESD22-A114-A
2. Tested to JESD22-C101-A
3. Tested to EIA/JESD78

RECOMMENDED OPERATING CONDITIONS

Symbol	Characteristics	Min	Max	Unit
V _{CC}	DC Supply Voltage	2.0	5.5	V
V _{IN}	DC Input Voltage	0.0	5.5	V
V _{OUT}	DC Output Voltage	0.0	7.0	V
T _A	Operating Temperature Range	−55	+125	°C
t _r , t _f	Input Rise and Fall Time	V _{CC} = 3.3 V ± 0.3 V V _{CC} = 5.0 V ± 0.5 V	0 10 5	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.



MC74VHC1G09E

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V _{CC} (V)	T _A = 25 °C			T _A ≤ 85 °C		-55 ≤ T _A ≤ 125 °C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
V _{IH}	Minimum High-Level Input Voltage		2.0 3.0 4.5 5.5	1.5 2.1 3.15 3.85			1.5 2.1 3.15 3.85		1.5 2.1 3.15 3.85		V
V _{IL}	Maximum Low-Level Input Voltage		2.0 3.0 4.5 5.5			0.5 0.9 1.35 1.65		0.5 0.9 1.35 1.65		0.5 0.9 1.35 1.65	V
V _{OL}	Maximum Low-Level Output Voltage V _{IN} = V _{IH} or V _{IL}	V _{IN} = V _{IH} or V _{IL} I _{OL} = 50 μA	2.0 3.0 4.5		0.0 0.0 0.0	0.1 0.1 0.1		0.1 0.1 0.1		0.1 0.1 0.1	V
		V _{IN} = V _{IH} or V _{IL} I _{OL} = 4 mA I _{OL} = 8 mA	3.0 4.5			0.36 0.36		0.44 0.44		0.52 0.52	V
I _{IN}	Maximum Input Leakage Current	V _{IN} = 5.5 V or GND	0 to 5.5			±0.1		±1.0		±1.0	μA
I _{CC}	Maximum Quiescent Supply Current	V _{IN} = V _{CC} or GND	5.5			1.0		20		40	μA
I _{OFF}	Power Off-Output Leakage Current	V _{OUT} = 5.5 V V _{IN} = 5.5 V	0			0.25		2.5		5	μA

AC ELECTRICAL CHARACTERISTICS Input t_r = t_f = 3.0 ns

Symbol	Parameter	Test Conditions	T _A = 25 °C			T _A ≤ 85 °C		-55 ≤ T _A ≤ 125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t _{pZL}	Maximum Output Enable Time, Input A or B to Y	V _{CC} = 3.3 ± 0.3 V C _L = 15 pF R _L = 1000 Ω C _L = 50 pF		6.2 8.7	8.8 12.3		10.5 14.0		12.5 16.5	ns
		V _{CC} = 5.0 ± 0.5 V C _L = 15 pF R _L = 1000 Ω C _L = 50 pF		4.3 5.8	5.9 7.9		7.0 9.0		9.0 11.0	
t _{pLZ}	Maximum Output Disable Time	V _{CC} = 3.3 ± 0.3 V C _L = 50 pF R _L = 1000 Ω		8.7	12.3		14.0		16.5	ns
		V _{CC} = 5.0 ± 0.5 V C _L = 50 pF R _L = 1000 Ω		5.8	7.9		9.0		11.0	
C _{IN}	Maximum Input Capacitance			6.0	10		10		10	pF

C _{PD}	Power Dissipation Capacitance (Note 4)	Typical @ 25°C, V _{CC} = 5.0 V	pF
		18	

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.

4. C_{PD} 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} • V_{CC} • f_{in} + I_{CC}. C_{PD} is used to determine the no-load dynamic power consumption; P_D = C_{PD} • V_{CC}² • f_{in} + I_{CC} • V_{CC}.



MC74VHC1G09E

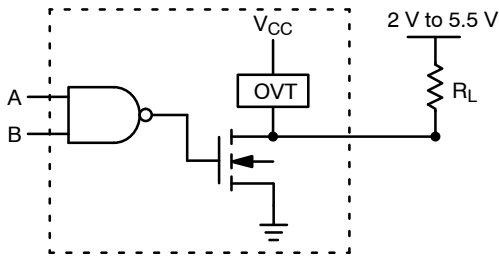


Figure 3. Output Voltage Mismatch Application

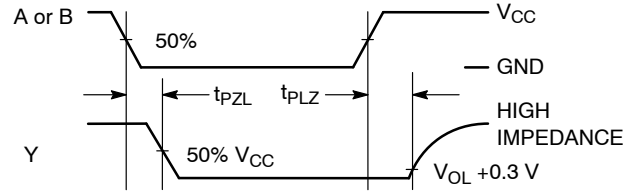
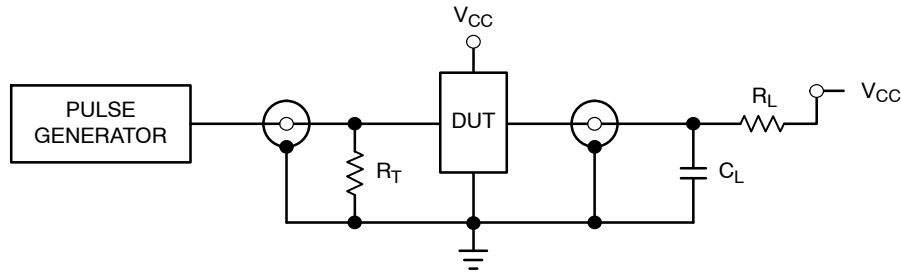


Figure 4. Switching Waveforms



$C_L = 50 \text{ pF}$ equivalent (Includes jig and probe capacitance)
 $R_L = 1000 \Omega$ or equivalent
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Figure 5. Test Circuit

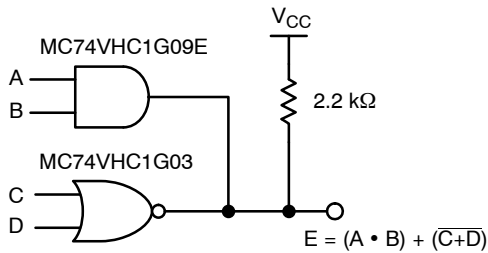


Figure 6. Complex Boolean Functions

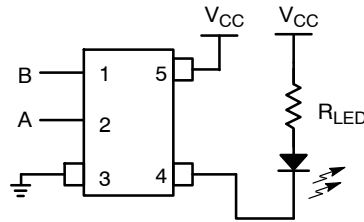


Figure 7. LED Driver

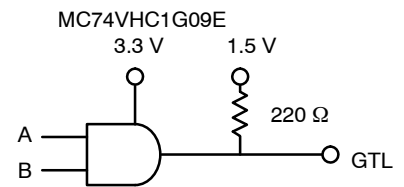


Figure 8. GTL Driver

ORDERING INFORMATION

Device	Package	Shipping†
MC74VHC1G09EDFT2G	SC70-5 / SC-88A / SOT-353 (Pb-Free)	3000/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](#).

MC74VHC1G09E

REVISION HISTORY

Revision	Description of Changes	Date
2	Rebranded the Data Sheet to onsemi format.	11/13/2025

This document has undergone updates prior to the inclusion of this revision history table. The changes tracked here only reflect updates made on the noted approval dates.



MC74VHC1G09E

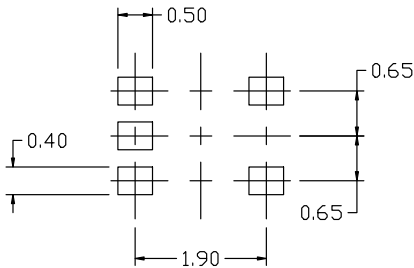
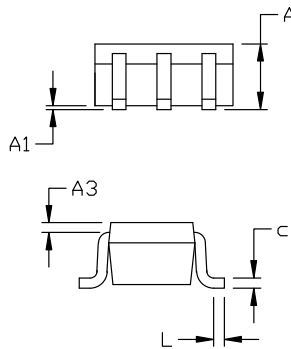
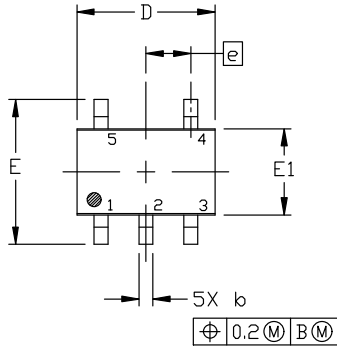
PACKAGE DIMENSIONS



SCALE 2:1

SC-88A (SC-70-5/SOT-353)
CASE 419A-02
ISSUE M

DATE 11 APR 2023



RECOMMENDED MOUNTING FOOTPRINT

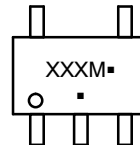
* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. 419A-01 OBSOLETE. NEW STANDARD 419A-02
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.1016MM PER SIDE.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.80	0.95	1.10
A1	---	---	0.10
A3	0.20 REF		
b	0.10	0.20	0.30
c	0.10	---	0.25
D	1.80	2.00	2.20
E	2.00	2.10	2.20
E1	1.15	1.25	1.35
e	0.65 BSC		
L	0.10	0.15	0.30

GENERIC MARKING DIAGRAM*



*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

XXX = Specific Device Code

M = Date Code

▪ = Pb-Free Package

(Note: Microdot may be in either location)

STYLE 1:

- PIN 1. BASE
2. EMITTER
3. BASE
4. COLLECTOR
5. COLLECTOR

STYLE 2:

- PIN 1. ANODE
2. EMITTER
3. BASE
4. COLLECTOR
5. CATHODE

STYLE 3:

- PIN 1. ANODE 1
2. N/C
3. ANODE 2
4. CATHODE 2
5. CATHODE 1

STYLE 4:

- PIN 1. SOURCE 1
2. DRAIN 1/2
3. SOURCE 1
4. GATE 1
5. GATE 2

STYLE 5:

- PIN 1. CATHODE
2. COMMON ANODE
3. CATHODE 2
4. CATHODE 3
5. CATHODE 4

STYLE 6:

- PIN 1. EMITTER 2
2. BASE 2
3. EMITTER 1
4. COLLECTOR
5. COLLECTOR 2/BASE 1

STYLE 7:

- PIN 1. BASE
2. EMITTER
3. BASE
4. COLLECTOR
5. COLLECTOR

STYLE 8:

- PIN 1. CATHODE
2. COLLECTOR
3. N/C
4. BASE
5. EMITTER

STYLE 9:

- PIN 1. ANODE
2. CATHODE
3. ANODE
4. ANODE
5. ANODE

Note: Please refer to datasheet for style callout. If style type is not called out in the datasheet refer to the device datasheet pinout or pin assignment.



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