![National Semiconductor logo] **N**ational *Semiconductor*

74VHC08 • 74VHCT08
Quad 2-Input AND Gate

General Description

The 74VHC/VHCT08 is an advanced high speed CMOS 2 Input AND Gate fabricated with silicon gate CMOS technology. It achieves the high-speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

The internal circuit is composed of 4 stages including buffer output, which provide high noise immunity and stable output. An input protection circuit insures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery backup. This circuit prevents device destruction due to mismatched supply and input voltages.

Features

- High noise immunity:
  VHC $V_{NIH} = V_{NIL} = 28\%$ V_{CC} (min)
  VHCT $V_{IH} = 2.0V$, $V_{IL} = 0.8V$
- Power down protection:
  VHC inputs only
  VHCT inputs and outputs
- Low noise: $V_{OLP} = 0.8V$ (max)
- Low power dissipation:
  $I_{CC} = 2\ \mu A$ (Max) @ $T_A = 25°C$
- Balanced propagation delays: $t_{PLH} \cong t_{PHL}$
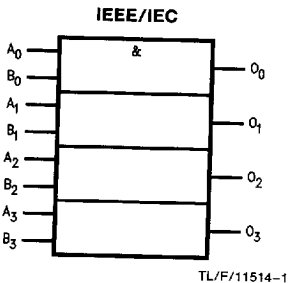- Pin and function compatible with 74HC/HCT08

NOTE: Add external pull up resistor to VHCT outputs to drive CMOS inputs

Ordering Code: See Section 6

Commercial	Package Number	Package Description
74VHC08M	M14A	14-Lead Molded JEDEC SOIC
74VHC08SJ	M14D	14-Lead Molded EIAJ SOIC
74VHC08MSC	MSC14	14-Lead Molded EIAJ Type 1 SSOP
74VHC08MTC	MTC14	14-Lead Molded JEDEC Type 1 TSSOP
74VHC08N	N14A	14-Lead Molded DIP
74VHCT08M	M14A	14-Lead Molded JEDEC SOIC
74VHCT08SJ	M14D	14-Lead Molded EIAJ SOIC
74VHCT08MTC	MTC14	14-Lead Molded JEDEC Type 1 TSSOP
74VHCT08N	N14A	14-Lead Molded DIP

Note: Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering code. EIAJ Type 1 SSOP available on a Tape and Reel only, order MSCX.

Logic Symbol

IEEE/IEC

TL/F/11514–1

Connection Diagram

Pin Assignment for DIP, SSOP, TSSOP and SOIC

TL/F/11514–2
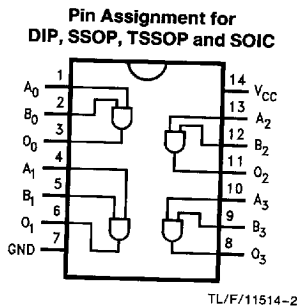
Pin Names	Description
A_n, B_n	Inputs
O_n	Outputs

Truth Table

A	B	O
L	L	L
L	H	L
H	L	L
H	H	H

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4-17

■ 6501122 0083611 820 ■

Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC}) −0.5V to +7.0V
DC Input Voltage (V_{IN}) −0.5V to +7.0V
DC Output Voltage (V_{OUT})
  VHC −0.5V to V_{CC} + 0.5V
  VHCT* −0.5V to 7.0V
Input Diode Current (I_{IK}) −20 mA
Output Diode Current (I_{OK})
  VHC ±20 mA
  VHCT −20 mA
DC Output Current (I_{OUT}) ±25 mA
DC V_{CC}/GND Current (I_{CC}) ±50 mA
Storage Temperature (T_{STG}) −65°C to +150°C
Lead Temperature (T_L)
  (Soldering, 10 seconds) 260°C

*V_{OUT} > V_{CC} only if output is in H state.

Note 1: *Absolute Maximum Ratings are values beyond which the device may be damaged or have its useful life impaired. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation outside databook specifications.*

Recommended Operating Conditions

Supply Voltage (V_{CC})
  VHC 2.0V to +5.5V
  VHCT 4.5V to 5.5V
Input Voltage (V_{IN}) 0V to +5.5V
Output Voltage (V_{OUT}) 0V to V_{CC}
Operating Temperature (T_{OPR}) −40°C to +85°C
Input Rise and Fall Time (t_r, t_f)
  V_{CC} = 3.3V ±0.3V (VHC only) 0 ns/V ~ 100 ns/V
  V_{CC} = 5.0V ±0.5V 0 ns/V ~ 20 ns/V

DC Characteristics for 'VHC Family Devices

Symbol	Parameter	V_{CC} (V)	74VHC T_A = 25°C			74VHC T_A = −40°C to +85°C		Units	Conditions	
			Min	Typ	Max	Min	Max			
V_{IH}	High Level Input Voltage	2.0	1.50			1.50		V		
		3.0–5.5	0.7 V_{CC}			0.7 V_{CC}				
V_{IL}	Low Level Input Voltage	2.0			0.50		0.50	V		
		3.0–5.5			0.3 V_{CC}		0.3 V_{CC}			
V_{OH}	High Level Output Voltage	2.0	1.9	2.0		1.9		V	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −50 µA
		3.0	2.9	3.0		2.9				
		4.5	4.4	4.5		4.4				
		3.0	2.58			2.48		V		I_{OH} = −4 mA
		4.5	3.94			3.80				I_{OH} = −8 mA
V_{OL}	Low Level Output Voltage	2.0		0.0	0.1		0.1	V	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 µA
		3.0		0.0	0.1		0.1			
		4.5		0.0	0.1		0.1			
		3.0			0.36		0.44	V		I_{OL} = 4 mA
		4.5			0.36		0.44			I_{OL} = 8 mA
I_{IN}	Input Leakage Current	0–5.5			±0.1		±1.0	µA	V_{IN} = 5.5V or GND	
I_{CC}	Quiescent Supply Current	5.5			2.0		20.0	µA	V_{IN} = V_{CC} or GND	

DC Characteristics for 'VHC Family Devices: See Section 2 for Waveforms

Symbol	Parameter	V_CC (V)	74VHC T_A = 25°C		Units	Conditions	Fig. No.
			Typ	Limits			
**V_OLP	Quiet Output Maximum Dynamic V_OL	5.0	0.3	0.8	V	$C_L = 50$ pF	2-11, 12
**V_OLV	Quiet Output Minimum Dynamic V_OL	5.0	−0.3	−0.8	V	$C_L = 50$ pF	2-11, 12
**V_IHD	Minimum High Level Dynamic Input Voltage	5.0		3.5	V	$C_L = 50$ pF	2-11, 12
**V_ILD	Maximum Low Level Dynamic Input Voltage	5.0		1.5	V	$C_L = 50$ pF	2-11, 12

**Parameter guaranteed by design.

DC Characteristics for 'VHCT Family Devices

Symbol	Parameter	V_CC (V)	74VHCT T_A = 25°C			74VHCT T_A = −40°C to +85°C		Units	Conditions	
			Min	Typ	Max	Min	Max			
V_IH	High Level Input Voltage	4.5	2.0			2.0		V		
		5.5	2.0			2.0				
V_IL	Low Level Input Voltage	4.5			0.8		0.8	V		
		5.5			0.8		0.8			
V_OH	High Level Output Voltage	4.5	3.15	3.65		3.15		V	$V_{IN} = V_{IH}$	$I_{OH} = -50 \mu A$
		4.5	2.5			2.4		V		$I_{OH} = -8$ mA
V_OL	Low Level Output Voltage	4.5		0.0	0.1		0.1	V	$V_{IN} = V_{IH}$	$I_{OL} = 50 \mu A$
		4.5			0.36		0.44	V		$I_{OL} = 8$ mA
I_IN	Input Leakage Current	0–5.5			±0.1		±1.0	μA	$V_{IN} = 5.5V$ or GND	
I_CC	Quiescent Supply Current	5.5			2.0		20.0	μA	$V_{IN} = V_{CC}$ or GND	
I_CCT	Maximum I_CC/ Input	5.5			1.35		1.50	mA	$V_{IN} = 3.4V$ Other Inputs = V_CC or GND	
I_OPD	Output Leakage Current (Power Down State)	0.0			0.5		5.0	μA	$V_{OUT} = 5.5V$	

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DC Characteristics for 'VHCT Family Devices: See Section 2 for Waveforms

Symbol	Parameter	V_{CC} (V)	74VHCT $T_A = 25°C$		Units	Conditions	Fig. No.
			Typ	Limit			
*V_{OLP}	Quiet Output Maximum Dynamic V_{OL}		0.4	0.8	V	$C_L = 50$ pF	2-11, 12
*V_{OLV}	Quiet Output Minimum Dynamic V_{OL}		−0.4	−0.8	V	$C_L = 50$ pF	2-11, 12
*V_{IHD}	Minimum High Level Dynamic Input Voltage			2.0	V	$C_L = 50$ pF	2-11, 12
*V_{ILD}	Maximum Low Level Dynamic Input Voltage			0.8	V	$C_L = 50$ pF	2-11, 12

*Parameter guaranteed by design.

AC Electrical Characteristics for 'VHC Family Devices: See Section 2 for Waveforms

Symbol	Parameter	V_{CC} (V)	74VHC $T_A = 25°C$			74VHC $T_A = -40°C$ to $+85°C$		Units	Conditions	Fig. No.
			Min	Typ	Max	Min	Max			
t_{PHL}, t_{PLH}	Propagation Delay	3.3±0.3		6.2	8.8	1.0	10.5	ns	$C_L = 15$ pF	2-5
				8.7	12.3	1.0	14.0		$C_L = 50$ pF	
		5.0±0.5		4.3	5.9	1.0	7.0	ns	$C_L = 15$ pF	
				5.8	7.9	1.0	9.0		$C_L = 50$ pF	
C_{IN}	Input Capacitance			4	10		10	pF	$V_{CC} = $ Open	
C_{PD}	Power Dissipation Capacitance			18				pF	(Note 1)	

Note 1: 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.) = $C_{PD} * V_{CC} * f_{IN} + I_{CC}/4$ (per gate).

AC Electrical Characteristics for 'VHCT Family Devices: See Section 2 for Waveforms

Symbol	Parameter	V_{CC} (V)	74VHCT $T_A = 25°C$			74VHCT $T_A = -40°C$ to $+85°C$		Units	Conditions	Fig. No.
			Min	Typ	Max	Min	Max			
t_{PLH}, t_{PHL}	Propagation Delay	5.0 ±0.5		5.0	6.9	1.0	8.0	ns	$C_L = 15$ pF	2-5
				5.5	7.9	1.0	9.0		$C_L = 50$ pF	2-5
C_{IN}	Input Capacitance			4	10		10	pF	$V_{CC} = $ Open	
C_{PD}	Power Dissipation Capacitance			18				pF	(Note 1)	

Note 1: 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 from the equation: I_{CC} (opr.) = $C_{PD} * V_{CC} * f_{IN} + I_{CC}/4$ (per gate)