

## 74VHC00 • 74VHCT00 Quad 2-Input NAND Gate

### General Description

The VHC/VHCT00 is an advanced high-speed CMOS 2-Input NAND 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 3 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

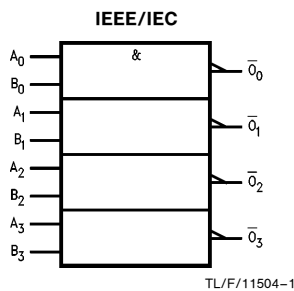
- High noise immunity:  
VHC  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)  
VHCT  $V_{IH} = 2.0V$ ,  $V_{IL} = 0.8V$
- Power down protection:  
VHC inputs only  
VHCT inputs and outputs
- Low noise:  $V_{OLP} = 0.8V$  (max)
- Low power dissipation:  
 $I_{CC} = 2 \mu A$  (max) at  $T_A = 25^\circ C$
- Balanced propagation delays:  $t_{PLH} \cong t_{PHL}$
- Pin and function compatible with 74HC/HCT00

**NOTE: ADD EXTERNAL PULL UP RESISTOR TO VHCT OUTPUTS TO DRIVE CMOS INPUTS**

Commercial	Package Number	Package Description
74VHC00M	M14A	14-Lead Molded JEDEC SOIC
74VHC00SJ	M14D	14-Lead Molded EIAJ SOIC
74VHC00MSC	MSC14	14-Lead Molded EIAJ Type 1 SSOP
74VHC00MTC	MTC14	14-Lead Molded JEDEC Type 1 TSSOP
74VHC00N	N14A	14-Lead Molded DIP
74VHCT00M	M14A	14-Lead Molded JEDEC SOIC
74VHCT00SJ	M14D	14-Lead Molded EIAJ SOIC
74VHCT00MTC	MTC14	14-Lead Molded JEDEC Type 1 TSSOP
74VHCT00N	N14A	14-Lead Molded DIP

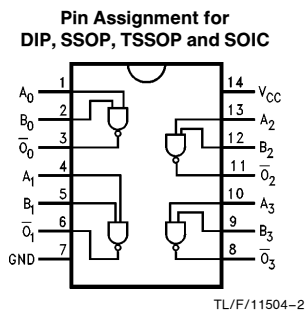
**Note:** Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter 'X' to the ordering code.  
EIAJ Type 1 SSOP available on Tape and Reel only, order MSCX.

### Logic Symbol



Pin Names	Description
An, Bn	Inputs
On	Outputs

### Connection Diagram



### Truth Table

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

## 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 ( $T_{OPR}$ )	
74VHC/VHCT	-40°C to +85°C
Input Rise and Fall Time ( $t_r, t_f$ )	
$V_{CC} = 3.3V \pm 0.3V$ (VHC Only)	0 ns/V ~ 100 ns/V
$V_{CC} = 5.0V \pm 0.5V$	0 ns/V ~ 20 ns/V

## DC Characteristics for 'VHC Family Devices

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

### DC Characteristics for 'VHC Family Devices

Symbol	Parameter	V <sub>CC</sub> (V)	74VHC		Units	Conditions
			T <sub>A</sub> = 25°C			
			Typ	Limit		
*V <sub>OLP</sub>	Quiet Output Maximum Dynamic V <sub>OL</sub>	5.0	0.3	0.8	V	C <sub>L</sub> = 50 pF
*V <sub>OLV</sub>	Quiet Output Minimum Dynamic V <sub>OL</sub>	5.0	-0.3	-0.8	V	C <sub>L</sub> = 50 pF
*V <sub>IHD</sub>	Minimum High Level Dynamic Input Voltage	5.0		3.5	V	C <sub>L</sub> = 50 pF
*V <sub>ILD</sub>	Maximum Low Level Dynamic Input Voltage	5.0		1.5	V	C <sub>L</sub> = 50 pF

\*Parameter guaranteed by design

### DC Characteristics for 'VHCT Family Devices

Symbol	Parameter	V <sub>CC</sub> (V)	74VHCT			74VHCT		Units	Conditions
			T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C			
			Min	Typ	Max	Min	Max		
V <sub>IH</sub>	High Level Input Voltage	4.5 5.5	2.0 2.0			2.0 2.0	V		
V <sub>IL</sub>	Low Level Input Voltage	4.5 5.5			0.8 0.8	0.8 0.8	V		
V <sub>OH</sub>	High Level Output Voltage	4.5	3.15	3.65		3.15	V	V <sub>IN</sub> = V <sub>IH</sub>   I <sub>OH</sub> = -50 μA	
		4.5	2.5			2.4	V	I <sub>OH</sub> = -8 mA	
V <sub>OL</sub>	Low Level Output Voltage	4.5		0.0	0.1		0.1	V	V <sub>IN</sub> = V <sub>IH</sub>   I <sub>OL</sub> = 50 μA
		4.5			0.36		0.44	V	I <sub>OL</sub> = 8 mA
I <sub>IN</sub>	Input Leakage Current	0-5.5			±0.1		±1.0	μA	V <sub>IN</sub> = 5.5V or GND
I <sub>CC</sub>	Quiescent Supply Current	5.5			2.0		20.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND
I <sub>CCT</sub>	Maximum I <sub>CC</sub> /Input	5.5			1.35		1.50	mA	V <sub>IN</sub> = 3.4V Other Inputs = V <sub>CC</sub> or GND
I <sub>OPD</sub>	Output Leakage Current (Power Down State)	0.0			0.5		5.0	μA	V <sub>OUT</sub> = 5.5V

## DC Characteristics for 'VHCT Family Devices

Symbol	Parameter	V <sub>CC</sub> (V)	74VHCT		Units	Conditions
			T <sub>A</sub> = 25°C			
			Typ	Limit		
*V <sub>OLP</sub>	Quiet Output Maximum Dynamic V <sub>OL</sub>	5.0	0.4	0.8	V	C <sub>L</sub> = 50 pF
*V <sub>OLV</sub>	Quiet Output Minimum Dynamic V <sub>OL</sub>	5.0	-0.4	-0.8	V	C <sub>L</sub> = 50 pF
*V <sub>IHD</sub>	Minimum High Level Dynamic Input Voltage	5.0		2.0	V	C <sub>L</sub> = 50 pF
*V <sub>ILD</sub>	Maximum Low Level Dynamic Input Voltage	5.0		0.8	V	C <sub>L</sub> = 50 pF

\*Parameter guaranteed by design.

## AC Electrical Characteristics for 'VHC Family Devices

Symbol	Parameter	V <sub>CC</sub> (V)	74VHC			74VHC		Units	Conditions
			T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C			
			Min	Typ	Max	Min	Max		
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay	3.3 ± 0.3	5.5	7.9	1.0	9.5	ns	C <sub>L</sub> = 15 pF	
			8.0	11.4	1.0	13.0		C <sub>L</sub> = 50 pF	
		5.0 ± 0.5	3.7	5.5	1.0	6.5	ns	C <sub>L</sub> = 15 pF	
			5.2	7.5	1.0	8.5		C <sub>L</sub> = 50 pF	
C <sub>IN</sub>	Input Capacitance		4	10	10	pF	V <sub>CC</sub> = Open		
C <sub>PD</sub>	Power Dissipation Capacitance		19			pF	(Note 1)		

**Note 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 from the equation: I<sub>CC</sub> (opr.) = C<sub>PD</sub> \* V<sub>CC</sub> \* f<sub>IN</sub> + I<sub>CC</sub>/4 (per gate).

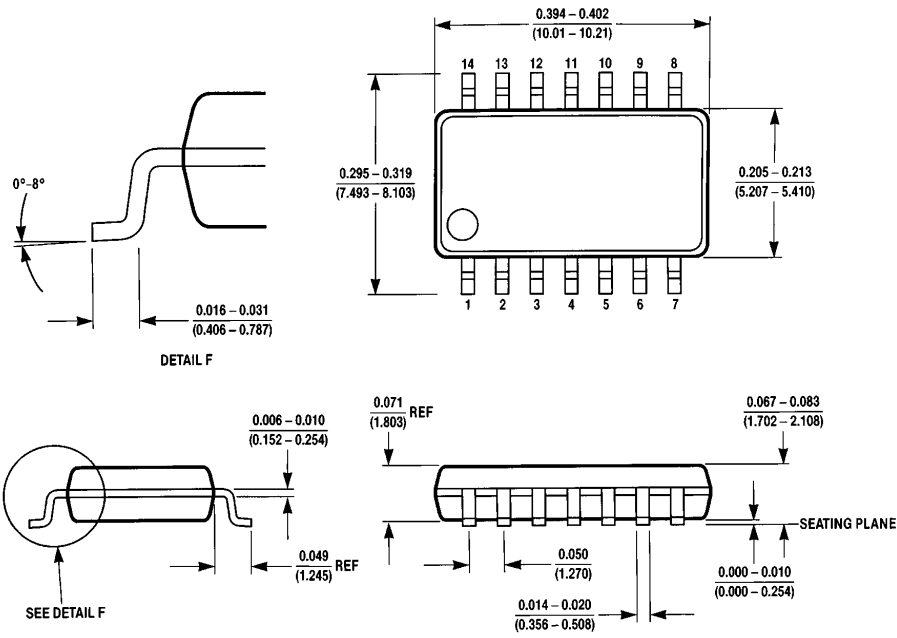
## AC Electrical Characteristics for 'VHCT Family Devices

Symbol	Parameter	V <sub>CC</sub> (V)	74VHCT			74VHCT		Units	Conditions
			T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C			
			Min	Typ	Max	Min	Max		
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay	5.0 ± 0.5	5.0	6.9	1.0	8.0	ns	C <sub>L</sub> = 15 pF	
			5.5	7.9	1.0	9.0		C <sub>L</sub> = 50 pF	
C <sub>IN</sub>	Input Capacitance		4	10	10	pF	V <sub>CC</sub> = Open		
C <sub>PD</sub>	Power Dissipation Capacitance		17			pF	(Note 1)		

**Note 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 from the equation: I<sub>CC</sub> (opr.) = C<sub>PD</sub> \* V<sub>CC</sub> \* f<sub>IN</sub> + I<sub>CC</sub>/4 (per gate)

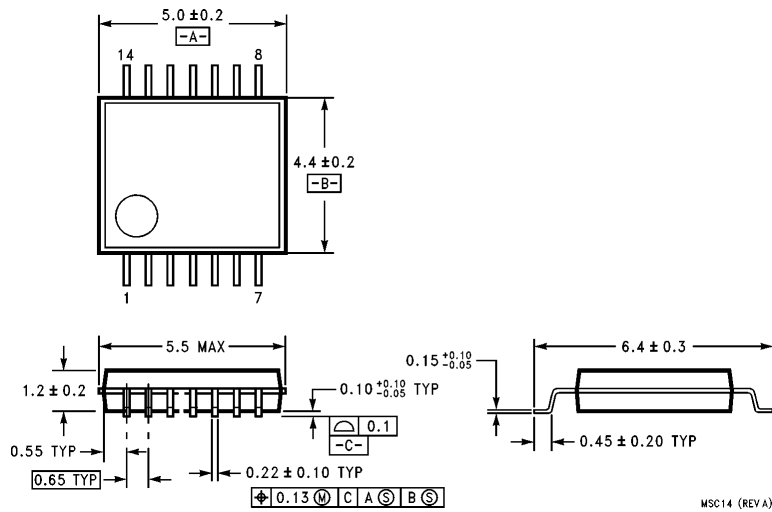


**Physical Dimensions** inches (millimeters) (Continued)



M14D (REV A)

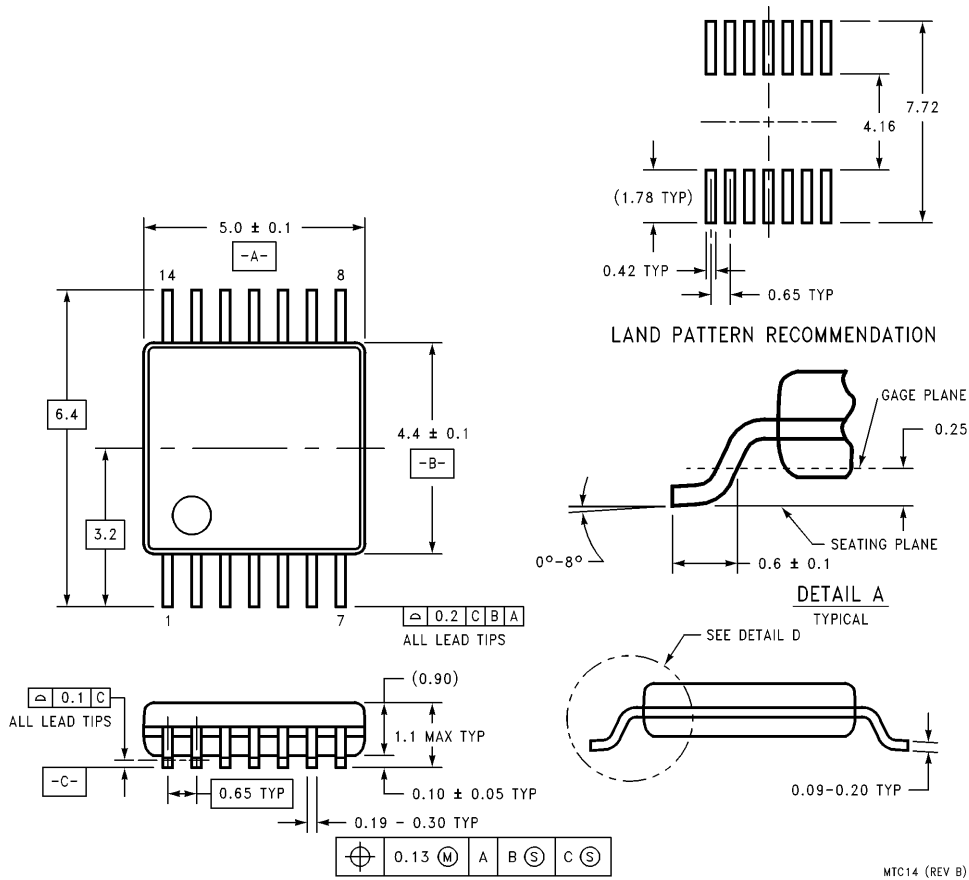
**14-Lead Plastic EIAJ SOIC (SJ)**  
**Order Number 74VHC00SJ, 74VHC00SJX, 74VHCT00SJ or 74VHCT00SJX**  
**NS Package Number M14D**



MSC14 (REV A)

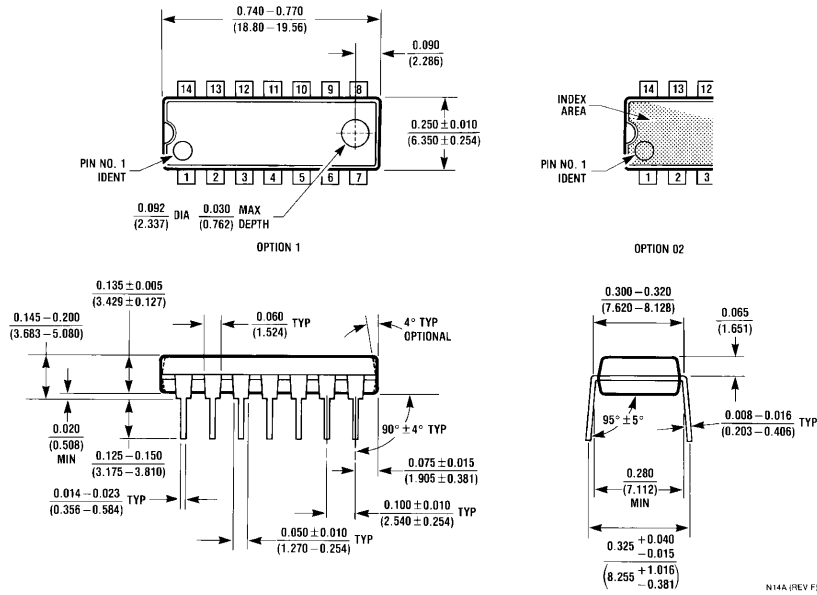
**14-Lead Plastic EIAJ SSOP Type I (MSC)**  
**Order Number 74VHC00MSCX**  
**NS Package Number MSC14**

**Physical Dimensions** inches (millimeters) (Continued)



**14-Lead Plastic JEDEC TSSOP Type 1 (MTC)**  
**Order Number 74VHC00MTC, 74VHC00MTCX, 74VHCT00MTC or 74VHCT00MTCX**  
**NS Package Number MTC14**

**Physical Dimensions** inches (millimeters) (Continued)



**14-Lead Molded DIP (P)**  
**Order Number 74VHC00N or 74VHCT00N**  
**NS Package Number N14A**

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



**National Semiconductor Corporation**  
 1111 West Bardin Road  
 Arlington, TX 76017  
 Tel: 1(800) 272-9959  
 Fax: 1(800) 737-7018

**National Semiconductor Europe**  
 Fax: (+49) 0-180-530 85 86  
 Email: cnjwge@tevm2.nsc.com  
 Deutsch Tel: (+49) 0-180-530 85 85  
 English Tel: (+49) 0-180-532 78 32  
 Français Tel: (+49) 0-180-532 93 58  
 Italiano Tel: (+49) 0-180-534 16 80

**National Semiconductor Hong Kong Ltd.**  
 19th Floor, Straight Block,  
 Ocean Centre, 5 Canton Rd.  
 Tsimshatsui, Kowloon  
 Hong Kong  
 Tel: (852) 2737-1600  
 Fax: (852) 2736-9960

**National Semiconductor Japan Ltd.**  
 Tel: 81-043-299-2309  
 Fax: 81-043-299-2408

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.