

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

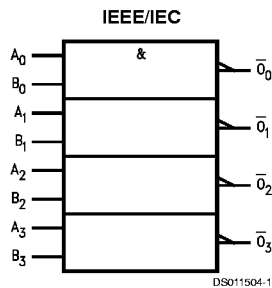
- High Speed:
 - VHC $t_{pd} = 3.7\text{ns}$ (typ) at $T_A = 25^\circ\text{C}$
 - VHCT $t_{pd} = 5.0\text{ns}$ (typ) at $T_A = 25^\circ\text{C}$
 - High noise immunity:
 - VHC $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min)
 - VHCT $V_{IH} = 2.0\text{V}$, $V_{IL} = 0.8\text{V}$
 - Power down protection:
 - VHC inputs only
 - VHCT inputs and outputs
 - Low noise: $V_{OLP} = 0.8\text{V}$ (max)
 - Low power dissipation:
 - $I_{CC} = 2\ \mu\text{A}$ (max) at $T_A = 25^\circ\text{C}$
 - Pin and function compatible with 74HC/HCT00
- NOTE: ADD EXTERNAL PULL UP RESISTOR TO VHCT OUTPUTS TO DRIVE CMOS INPUTS**

Ordering Code:

| Commercial | Package Number | Package Description |
|-------------|----------------|-----------------------------------|
| 74VHC00M | M14A | 14-Lead Molded JEDEC SOIC |
| 74VHC00SJ | M14D | 14-Lead Molded EIAJ SOIC |
| 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 |

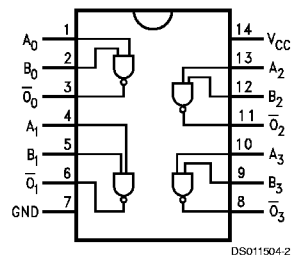
Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter 'X' to the ordering code.

Logic Symbol



Connection Diagram

Pin Assignment for DIP, TSSOP and SOIC



Pin Descriptions

| Pin Names | Description |
|-----------|-------------|
| An, Bn | Inputs |
| On | Outputs |

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 (Note 2) | -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 |

Recommended Operating Conditions (Note 3)

| | |
|---|-------------------|
| 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) | |
| $V_{CC} = 3.3V \pm 0.3V$ (VHC Only) | 0 ns/V ~ 100 ns/V |
| $V_{CC} = 5.0V \pm 0.5V$ | 0 ns/V ~ 20 ns/V |

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. Fairchild does not recommend operation outside databook specifications.

Note 2: $V_{OUT} > V_{CC}$ only if output is in H state.

Note 3: Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics for VHC

| Symbol | Parameter | V_{CC} (V) | $T_A = 25^\circ C$ | | | $T_A = -40^\circ C$ to $+85^\circ C$ | | Units | Conditions | |
|----------|---------------------------|-----------------|----------------------|------|----------------------|---|----------------------|---------|--------------------------------------|----------------------|
| | | | 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} | $I_{OH} = -50 \mu A$ |
| | | 3.0 | 2.9 | 3.0 | | 2.9 | | | | |
| | | 4.5 | 4.4 | 4.5 | | 4.4 | | V | $I_{OH} = -4 mA$ $I_{OH} = -8 mA$ | |
| | | 3.0 | 2.58 | | | 2.48 | | | | |
| 4.5 | 3.94 | | | 3.80 | | | | | | |
| V_{OL} | Low Level Output Voltage | 2.0 | | 0.0 | 0.1 | | 0.1 | V | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OL} = 50 \mu A$ |
| | | 3.0 | | 0.0 | 0.1 | | 0.1 | | | |
| | | 4.5 | | 0.0 | 0.1 | | 0.1 | V | $I_{OL} = 4 mA$ $I_{OL} = 8 mA$ | |
| | | 3.0 | | | 0.36 | | 0.44 | | | |
| 4.5 | | | 0.36 | | 0.44 | | | | | |
| 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 | |

Noise Characteristics for VHC

| Symbol | Parameter | V _{CC} (V) | T _A = 25° C | | Units | Conditions |
|------------------------------|---|------------------------|------------------------|-------|-------|------------------------|
| | | | Typ | Limit | | |
| V _{OLP} (Note 4) | Quiet Output Maximum Dynamic V _{OL} | 5.0 | 0.3 | 0.8 | V | C _L = 50 pF |
| V _{OLV} (Note 4) | Quiet Output Minimum Dynamic V _{OL} | 5.0 | -0.3 | -0.8 | V | C _L = 50 pF |
| V _{IHD} (Note 4) | Minimum High Level Dynamic Input Voltage | 5.0 | | 3.5 | V | C _L = 50 pF |
| V _{ILD} (Note 4) | Maximum Low Level Dynamic Input Voltage | 5.0 | | 1.5 | V | C _L = 50 pF |

Note 4: Parameter guaranteed by design

AC Electrical Characteristics for VHC

| Symbol | Parameter | V _{CC} (V) | T _A = 25° C | | | T _A = -40° C to +85° C | | Units | Conditions |
|------------------|----------------------------------|------------------------|------------------------|-----|------|--------------------------------------|------|-------|------------------------|
| | | | Min | Typ | Max | Min | Max | | |
| t _{PLH} | Propagation Delay | 3.3 ± 0.3 | | 5.5 | 7.9 | 1.0 | 9.5 | ns | C _L = 15 pF |
| t _{PHL} | | | | 8.0 | 11.4 | 1.0 | 13.0 | | C _L = 50 pF |
| | | 5.0 ± 0.5 | | 3.7 | 5.5 | 1.0 | 6.5 | ns | C _L = 15 pF |
| | | | | 5.2 | 7.5 | 1.0 | 8.5 | | C _L = 50 pF |
| C _{IN} | Input Capacitance | | | 4 | 10 | | 10 | pF | V _{CC} = Open |
| C _{PD} | Power Dissipation Capacitance | | | 19 | | | | pF | (Note 5) |

Note 5: 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).

DC Electrical Characteristics for VHCT

| Symbol | Parameter | V _{CC} (V) | T _A = 25° C | | | T _A = -40° C to +85° C | | Units | Conditions | |
|--------------------|--|------------------------|------------------------|------|------|--------------------------------------|------|-------|--|--|
| | | | Min | Typ | Max | Min | Max | | | |
| V _{IH} | High Level Input Voltage | 4.5 5.5 | 2.0 | | | 2.0 | | V | | |
| | | | 2.0 | | | 2.0 | | | | |
| V _{IL} | Low Level Input Voltage | 4.5 5.5 | | | 0.8 | | 0.8 | V | | |
| | | | | | 0.8 | | 0.8 | | | |
| V _{OH} | High Level Output Voltage | 4.5 4.5 | 3.15 | 3.65 | | 3.15 | | V | V _{IN} = V _{IH} I _{OH} = -50 μA I _{OH} = -8 mA | |
| | | | 2.5 | | | 2.4 | | | | |
| V _{OL} | Low Level Output Voltage | 4.5 4.5 | | 0.0 | 0.1 | | 0.1 | V | V _{IN} = V _{IH} I _{OL} = 50 μA I _{OL} = 8 mA | |
| | | | | | 0.36 | | 0.44 | | | |
| 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 _{CC(T)} | Maximum I _{CC} / Input | 5.5 | | | 1.35 | | 1.50 | mA | V _{IN} = 3.4V Other Inputs = V _{CC} or GND | |
| I _{OFF} | Output Leakage Current (Power Down State) | 0.0 | | | 0.5 | | 5.0 | μA | V _{OUT} = 5.5V | |

Noise Characteristics for VHCT

| Symbol | Parameter | V _{CC} (V) | T _A = 25° C | | Units | Conditions |
|------------------------------|---|------------------------|------------------------|-------|-------|------------------------|
| | | | Typ | Limit | | |
| V _{OLP} (Note 6) | Quiet Output Maximum Dynamic V _{OL} | 5.0 | 0.4 | 0.8 | V | C _L = 50 pF |
| V _{OLV} (Note 6) | Quiet Output Minimum Dynamic V _{OL} | 5.0 | -0.4 | -0.8 | V | C _L = 50 pF |
| V _{IHD} (Note 6) | Minimum High Level Dynamic Input Voltage | 5.0 | | 2.0 | V | C _L = 50 pF |
| V _{ILD} (Note 6) | Maximum Low Level Dynamic Input Voltage | 5.0 | | 0.8 | V | C _L = 50 pF |

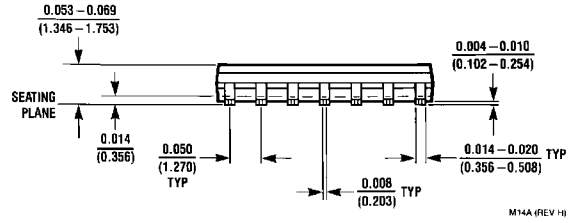
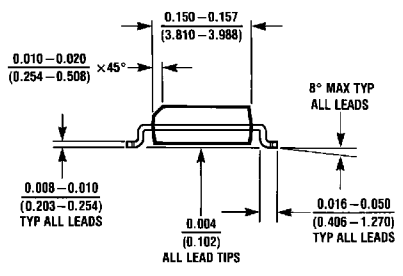
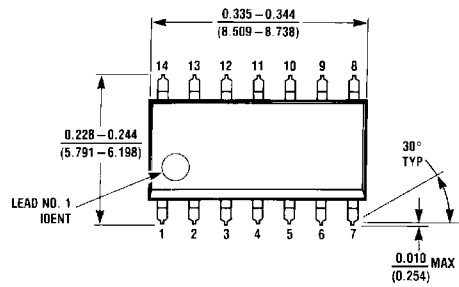
Note 6: Parameter guaranteed by design.

AC Electrical Characteristics for VHCT

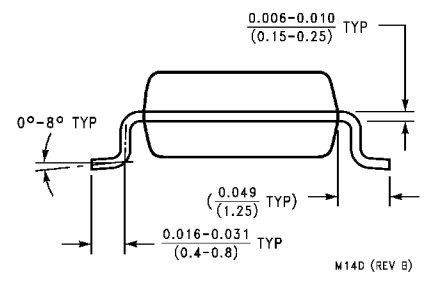
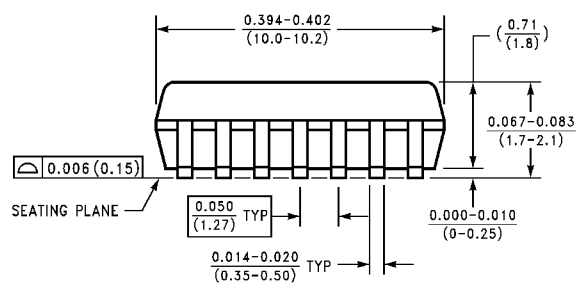
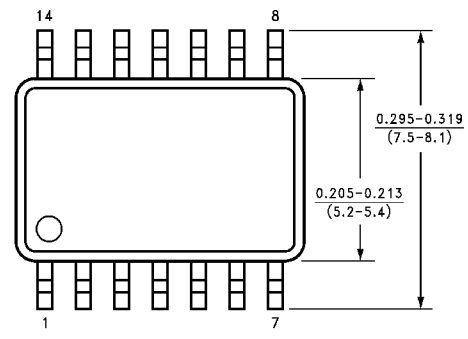
| Symbol | Parameter | V _{CC} (V) | T _A = 25° C | | | T _A = -40° C to +85° C | | Units | Conditions | Fig. No. |
|------------------|----------------------------------|------------------------|------------------------|-----|-----|--------------------------------------|-----|-------|------------------------|-------------|
| | | | Min | Typ | Max | Min | Max | | | |
| t _{PLH} | Propagation Delay | 5.0 | | 5.0 | 6.9 | 1.0 | 8.0 | ns | C _L = 15 pF | |
| t _{PHL} | | ±0.5 | | 5.5 | 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 | | | 17 | | | | pF | (Note 7) | |

Note 7: 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)

Physical Dimensions inches (millimeters) unless otherwise noted

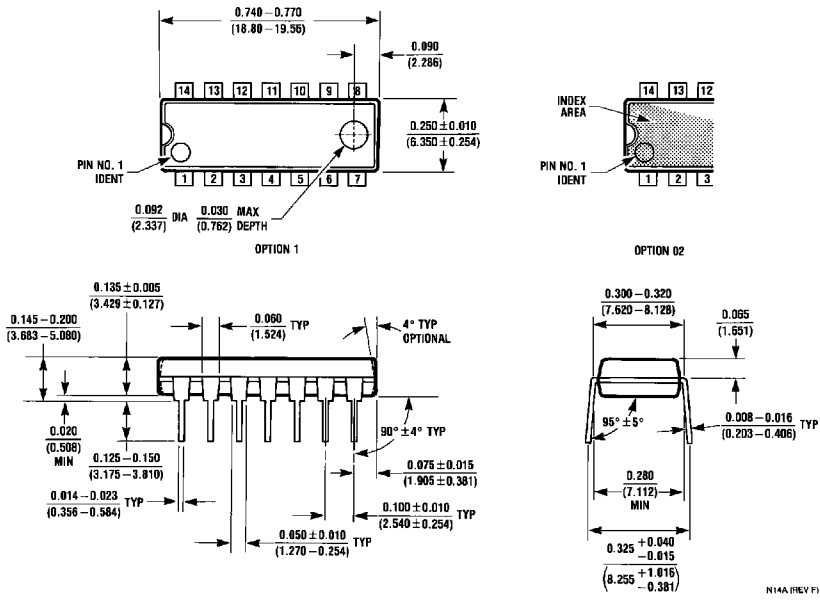


**14-Lead Small Outline Integrated Circuit—JEDEC (M)
Package Number M14A**



**14-Lead Plastic EIAJ SOIC (SJ)
Package Number M14D**

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



**14-Lead Molded DIP (P)
Package Number N14A**

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