FAIRCHILD SEMICONDUCTOR™

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# 74VCX132

# Low Voltage Quad 2-Input NAND Gate with Schmitt Trigger Inputs and 3.6V Tolerant Inputs and Outputs

## General Description

The VCX132 contains four 2-input NAND gates with Schmitt Trigger Inputs. The pin configuration and function are the same as the VCX00 except the inputs have hysteresis between the positive-going and negative-going input thresholds. This hysteresis is useful for transforming slowly switching input signals into sharply defined, jitter-free output signals. This product should be used where noise margin greater than that of conventional gates is required.

The VCX132 is designed for low voltage (1.65V to 3.6V) $V_{CC}$ applications with I/O compatibility up to 3.6V.

This product is fabricated with an advanced CMOS technology to achieve high-speed operation while maintaining low CMOS power dissipation.

## Features

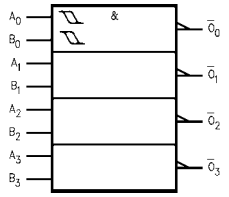
- 1.65V-3.6V $V_{CC}$ supply operation
- 3.6V tolerant inputs and outputs
- $t_{PD}$
  - 3.3 ns max for 3.0V to 3.6V $V_{CC}$
  - 4.1 ns max for 2.3V to 2.7V $V_{CC}$
  - 8.2 ns max for 1.65V to 1.95V $V_{CC}$
- Power-off high impedance inputs and outputs
- Static Drive ($I_{OH}/I_{OL}$)
  - ±24 mA @ 3.0V $V_{CC}$
  - ±18 mA @ 2.3V $V_{CC}$
  - ±6 mA @ 1.65V $V_{CC}$
- Uses patented Quiet Series™ noise/EMI reduction circuitry
- Latchup performance exceeds 300 mA
- ESD performance:
  - Human body model > 2000V
  - Machine model > 250V

## Ordering Code:

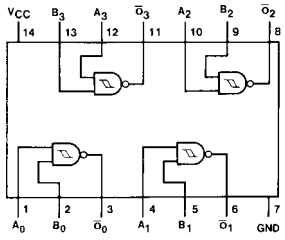
| Order Number | Package Number | Package Description |
|---|---|---|
| 74VCX132M | M14A | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow |
| 74VCX132MTC | MTC14 | 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide |

Devices also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

## Logic Diagram




## Connection Diagram




## Pin Descriptions

| Pin Name | Description |
|---|---|
| $A_n$, $B_n$ | Inputs |
| $\overline{O}_n$ | Outputs |

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## Absolute Maximum Ratings (Note 1)

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | −0.5V to +4.6V |
| DC Input Voltage ($V_I$) | −0.5V to 4.6V |
| DC Output Voltage ($V_O$) | |
| HIGH or LOW State (Note 2) | −0.5V to $V_{CC}$ + 0.5V |
| $V_{CC}$ = 0V | −0.5V to +4.6V |
| DC Input Diode Current ($I_{IK}$) | |
| $V_I$ < 0V | −50 mA |
| DC Output Diode Current ($I_{OK}$) | |
| $V_O$ < 0V | −50 mA |
| $V_O$ > $V_{CC}$ | +50 mA |
| DC Output Source/Sink Current ($I_{OH}/I_{OL}$) | ±50 mA |
| DC $V_{CC}$ or Ground Current per Supply Pin ($I_{CC}$ or Ground) | ±100 mA |
| Storage Temperature ($T_{STG}$) | −65°C to +150°C |

## Recommended Operating Conditions (Note 3)

| | |
|---|---|
| Power Supply | |
| Operating | 1.65V to 3.6V |
| Data Retention Only | 1.2V to 3.6V |
| Input Voltage | −0.3V to 3.6V |
| Output Voltage ($V_O$) | |
| HIGH or LOW State | 0V to $V_{CC}$ |
| Output Current in $I_{OH}/I_{OL}$ | |
| $V_{CC}$ = 3.0V to 3.6V | ±24 mA |
| $V_{CC}$ = 2.3V to 2.7V | ±18 mA |
| $V_{CC}$ = 1.65V to 2.3V | ±6 mA |
| Free Air Operating Temperature ($T_A$) | −40°C to +85°C |

**Note 1:** The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Note 2:** $I_O$ Absolute Maximum Rating must be observed.

**Note 3:** Floating or unused inputs must be held HIGH or LOW.

## DC Electrical Characteristics ($2.7V < V_{CC} \leq 3.6V$)

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | Min | Max | Units |
|---|---|---|---|---|---|---|
| $V_{t+}$ | Positive Threshold | | 3.6 | | 2.2 | V |
| | | | 3.0 | | 2.0 | |
| $V_{t-}$ | Negative Threshold | | 3.6 | 0.8 | | V |
| | | | 3.0 | 0.7 | | |
| $V_H$ | Input Hysteresis | | 3.6 | 0.3 | 1.2 | V |
| | | | 3.0 | 0.3 | 1.2 | |
| $V_{OH}$ | HIGH Level Output Voltage | $I_{OH}$ = −100 µA | 2.7–3.6 | $V_{CC}$–0.2 | | V |
| | | $I_{OH}$= −12 mA | 2.7 | 2.2 | | |
| | | $I_{OH}$ = −18 mA | 3.0 | 2.4 | | |
| | | $I_{OH}$ = −24mA | 3.0 | 2.2 | | |
| $V_{OL}$ | LOW Level Output Voltage | $I_{OL}$ = 100 µA | 2.7–3.6 | | 0.2 | V |
| | | $I_{OL}$ = 12 µA | 2.7 | | 0.4 | |
| | | $I_{OL}$ = 18 mA | 3.0 | | 0.4 | |
| | | $I_{OL}$ = 24 mA | 3.0 | | 0.55 | |
| $I_I$ | Input Leakage Current | 0 ≤ $V_I$ ≤ 3.6V | 2.7–3.6 | | ±15.0 | µA |
| $I_{OFF}$ | Power Off Leakage Current | 0 ≤ ($V_I$, $V_O$) ≤ 3.6V | 0 | | 10 | µA |
| $I_{CC}$ | Quiescent Supply Current | $V_I$ = $V_{CC}$ or GND | 2.7–3.6 | | 20 | µA |
| | | $V_{CC}$ ≤ $V_I$ ≤ 3.6V | 2.7–3.6 | | ±20 | |
| $\Delta I_{CC}$ | Increase in $I_{CC}$ per Input | $V_{IH}$ = $V_{CC}$ − 0.6V | 2.7–3.6 | | 750 | µA |

## DC Electrical Characteristics ($2.3V \leq V_{CC} \leq 2.7V$)

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | Min | Max | Units |
|---|---|---|---|---|---|---|
| $V_t+$ | Positive Threshold | | 2.3 | | 1.6 | V |
| $V_t-$ | Negative Threshold | | 2.3 | 0.5 | | V |
| $\Delta V_T$ | Input Hysteresis | | 2.3 | 0.3 | 1.0 | V |
| $V_{OH}$ | HIGH Level Output Voltage | $I_{OH} = -100\ \mu A$ | 2.3–2.7 | $V_{CC}-0.2$ | | V |
| | | $I_{OH} = -6$ mA | 2.3 | 2.0 | | |
| | | $I_{OH} = -12$ mA | 2.3 | 1.8 | | |
| | | $I_{OH} = -18$ mA | 2.3 | 1.7 | | |
| $V_{OL}$ | LOW Level Output Voltage | $I_{OL} = 100\ \mu A$ | 2.3–2.7 | | 0.2 | V |
| | | $I_{OL} = 12\ \mu A$ | 2.3 | | 0.4 | |
| | | $I_{OL} = 18$ mA | 2.3 | | 0.6 | |
| $I_I$ | Input Leakage Current | $0 \leq V_I \leq 3.6V$ | 2.3–2.7 | | ±5.0 | μA |
| $I_{OFF}$ | Power Off Leakage Current | $0 \leq (V_I, V_O) \leq 3.6V$ | 0 | | 10 | μA |
| $I_{CC}$ | Quiescent Supply Current | $V_I = V_{CC}$ or GND | 2.3–2.7 | | 20 | μA |
| | | $V_{CC} \leq V_I \leq 3.6V$ | 2.3–2.7 | | ±20 | |

## DC Electrical Characteristics ($1.65V \leq V_{CC} < 2.3V$)

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | Min | Max | Units |
|---|---|---|---|---|---|---|
| $V_t+$ | Positive Threshold | | 1.65 | | 1.3 | V |
| $V_t-$ | Negative Threshold | | 1.65 | 0.25 | | V |
| $\Delta V_T$ | Input Hysteresis | | 1.65 | 0.2 | 0.9 | V |
| $V_{OH}$ | HIGH Level Output Voltage | $I_{OH} = -100\ \mu A$ | 1.65–2.3 | $V_{CC}-0.2$ | | V |
| | | $I_{OH} = -6$ mA | 1.65 | 1.25 | | |
| $V_{OL}$ | LOW Level Output Voltage | $I_{OL} = 100\ \mu A$ | 1.65–2.3 | | 0.2 | V |
| | | $I_{OL} = 6$ mA | 1.65 | | 0.3 | |
| $I_I$ | Input Leakage Current | $0 \leq V_I \leq 3.6V$ | 1.65–2.3 | | ±5.0 | μA |
| $I_{OFF}$ | Power Off Leakage Current | $0 \leq (V_I, V_O) \leq 3.6V$ | 0 | | 10 | μA |
| $I_{CC}$ | Quiescent Supply Current | $V_I = V_{CC}$ or GND | 1.65–2.3 | | 20 | μA |
| | | $V_{CC} \leq V_I \leq 3.6V$ | 1.65–2.3 | | ±20 | |

## AC Electrical Characteristics (Note 4)

| Symbol | Parameter | $T_A = -40°C$ to $+85°C$, $C_L = 30$ pF, $R_L = 500\Omega$ | | | | | | Units |
|---|---|---|---|---|---|---|---|---|
| | | $V_{CC} = 3.3\ V \pm 0.3V$ | | $V_{CC} = 2.5\ V \pm 0.2V$ | | $V_{CC} = 1.8\ V \pm 0.15V$ | | |
| | | Min | Max | Min | Max | Min | Max | |
| $t_{PHL}$ | Propagation Delay | 0.6 | 3.3 | 0.8 | 4.1 | 1.0 | 8.2 | ns |
| $t_{PLH}$ | | | | | | | | |
| $t_{OSHL}$ | Output to Output | | 0.5 | | 0.5 | | 0.75 | ns |
| $t_{OSLH}$ | Skew (Note 5) | | | | | | | |

**Note 4:** For $C_L = 50$ pF, add approximately 300 ps to the AC maximum specification.

**Note 5:** Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW ($t_{OSHL}$) or LOW-to-HIGH ($t_{OSLH}$).

## Dynamic Switching Characteristics

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | $T_A = +25°C$ Typical | Units |
|---|---|---|---|---|---|
| $V_{OLP}$ | Quiet Output Dynamic Peak $V_{OL}$ | $C_L$ = 30 pF, $V_{IH} = V_{CC}$, $V_{IL}$ = 0V | 1.8 | 0.25 | V |
| | | | 2.5 | 0.6 | |
| | | | 3.3 | 0.8 | |
| $V_{OLV}$ | Quiet Output Dynamic Valley $V_{OL}$ | $C_L$ = 30 pF, $V_{IH} = V_{CC}$, $V_{IL}$ = 0V | 1.8 | –0.25 | V |
| | | | 2.5 | –0.6 | |
| | | | 3.3 | –0.8 | |
| $V_{OHV}$ | Quiet Output Dynamic Valley $V_{OH}$ | $C_L$ = 30 pF, $V_{IH} = V_{CC}$, $V_{IL}$ = 0V | 1.8 | 1.5 | V |
| | | | 2.5 | 1.9 | |
| | | | 3.3 | 2.2 | |

## Capacitance

| Symbol | Parameter | Conditions | $T_A = +25°C$ Typical | Units |
|---|---|---|---|---|
| $C_{IN}$ | Input Capacitance | $V_I$ = 0V or $V_{CC}$, $V_{CC}$ = 1.8V, 2.5V or 3.3V | 6 | pF |
| $C_{OUT}$ | Output Capacitance | $V_I$ = 0V or $V_{CC}$, $V_{CC}$ = 1.8V, 2.5V or 3.3V | 7 | pF |
| $C_{PD}$ | Power Dissipation Capacitance | $V_I$ = 0V or $V_{CC}$, f = 10MHz, $V_{CC}$ = 1.8V, 2.5V or 3.3V | 20 | pF |

## AC Loading and Waveforms

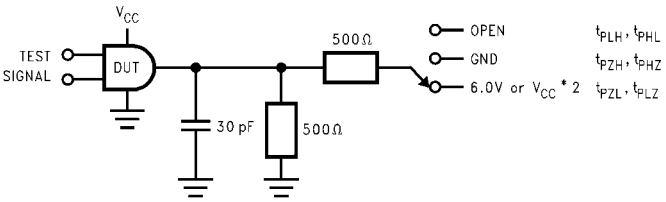



**FIGURE 1. AC Test Circuit**

| TEST | SWITCH |
|---|---|
| $t_{PLH}$, $t_{PHL}$ | Open |

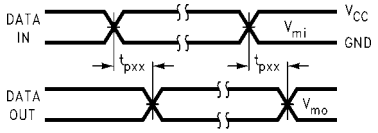
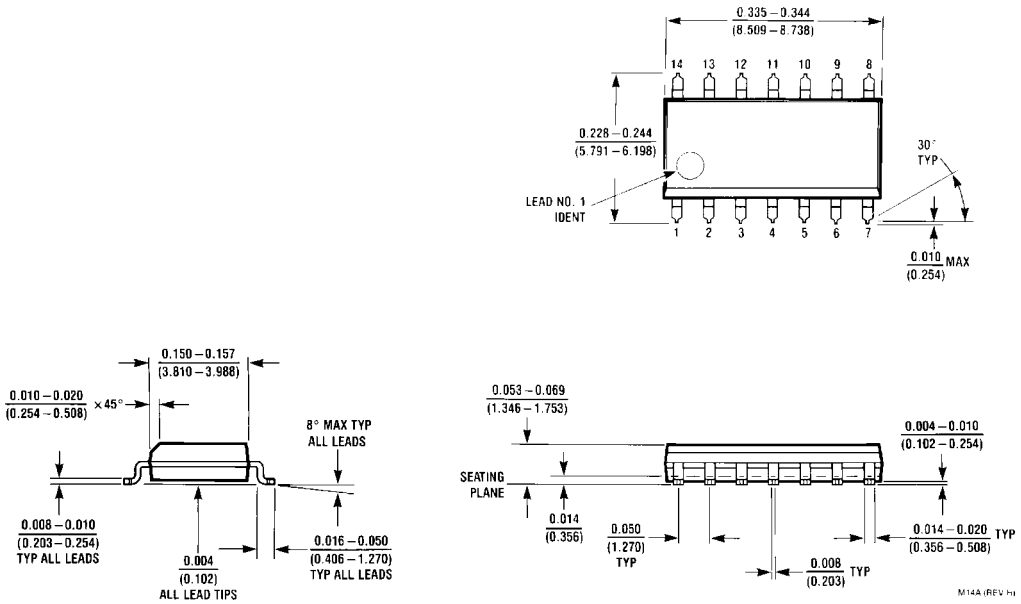



**FIGURE 2. Waveform for Inverting and Non-inverting Functions**

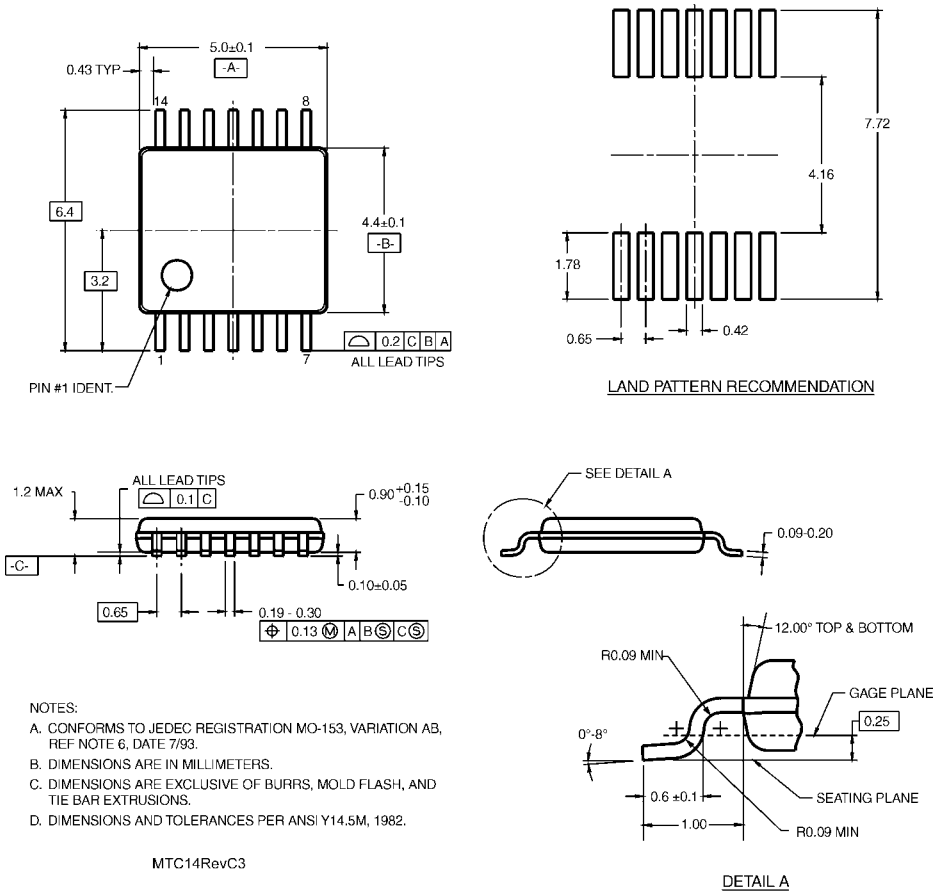
| Symbol | $V_{CC}$ | | |
|---|---|---|---|
| | 3.3V ± 0.3V | 2.5V ± 0.2V | 1.8V ± 0.15V |
| $V_{mi}$ | 1.5V | $V_{CC}$/2 | $V_{CC}$/2 |
| $V_{mo}$ | 1.5V | $V_{CC}$/2 | $V_{CC}$/2 |

## Physical Dimensions inches (millimeters) unless otherwise noted




**14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow**
**Package Number M14A**

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




NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6, DATE 7/93.

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

MTC14RevC3

**14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide**
**Package Number MTC14**



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