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 (1.4V 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

- 1.4V to 3.6V $V_{CC}$ supply operation
- 3.6V tolerant inputs and outputs
- $t_{PD}$
  3.3 ns max for 3.0V to 3.6V $V_{CC}$
- Power-off high impedance inputs and outputs
- Static Drive ($I_{OH}/I_{OL}$)
  ±24 mA @ 3.0V $V_{CC}$
- Uses patented Quiet Series™ noise/EMI reduction circuitry
- Latchup performance exceeds JEDEC 78 conditions
- ESD performance:
  Human body model > 2000V
  Machine model > 250V
- Leadless Pb-Free DQFN package

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## Ordering Code:

| Order Number | Package Number | Package Description |
|---|---|---|
| 74VCX132M | M14A | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| 74VCX132BQX (Note 1) | MLP014A | Pb-Free 14-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.0mm |
| 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.
Pb-Free package per JEDEC J-STD-020B.

**Note 1:** DQFN package available in Tape and Reel only.

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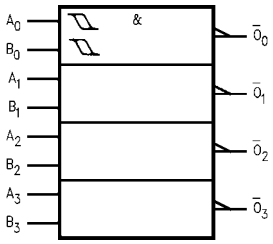
## Logic Diagram

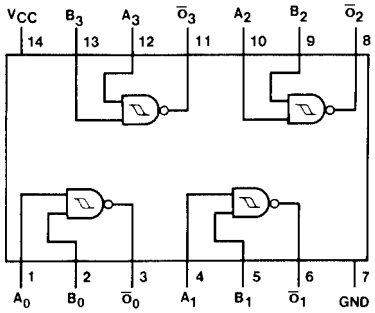



## Pin Descriptions

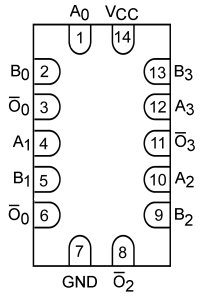
| Pin Name | Description |
|---|---|
| $A_n$, $B_n$ | Inputs |
| $\overline{O}_n$ | Outputs |

## Connection Diagrams

**Pin Assignments for SOIC and TSSOP**




**Pad Assignments for DQFN**




**(Top View)**

## Absolute Maximum Ratings (Note 2)

| | |
|---|---|
| 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 3) | −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 4)

| | |
|---|---|
| Power Supply | |
| Operating | 1.4V 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 |
| $V_{CC}$ = 1.4V to 1.6V | ±2 mA |
| Free Air Operating Temperature ($T_A$) | −40°C to +85°C |

**Note 2:** 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 3:** $I_O$ Absolute Maximum Rating must be observed.

**Note 4:** Floating or unused inputs must be held HIGH or LOW.

## DC Electrical Characteristics

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | Min | Max | Units |
|---|---|---|---|---|---|---|
| $V_{t+}$ | HIGH Level Input Voltage | | 3.6 | | 2.2 | |
| | | | 3.0 | | 2.0 | |
| | | | 2.3 | | 1.6 | V |
| | | | 1.6 | | 1.2 | |
| | | | 1.4 | | 1.2 | |
| $V_{t-}$ | LOW Level Input Voltage | | 3.6 | 0.8 | | |
| | | | 3.0 | 0.7 | | |
| | | | 2.3 | 0.5 | | V |
| | | | 1.6 | 0.2 | | |
| | | | 1.4 | 0.2 | | |
| $V_H$ | Input Hysteresis | | 3.6 | 0.3 | 1.2 | |
| | | | 3.0 | 0.3 | 1.2 | |
| | | | 2.3 | 0.3 | 1.0 | V |
| | | | 1.6 | 0.15 | 0.9 | |
| | | | 1.4 | 0.15 | 0.9 | |
| $V_{OH}$ | HIGH Level Output Voltage | $I_{OH}$ = −100 µA | 2.7 - 3.6 | $V_{CC}$ - 0.2 | | |
| | | $I_{OH}$= −12 mA | 2.7 | 2.2 | | |
| | | $I_{OH}$ = −18 mA | 3.0 | 2.4 | | |
| | | $I_{OH}$ = −24mA | 3.0 | 2.2 | | |
| | | $I_{OH}$ = −100 µA | 2.3 - 2.7 | $V_{CC}$ - 0.2 | | |
| | | $I_{OH}$ = −6 mA | 2.3 | 2.0 | | V |
| | | $I_{OH}$ = −12 mA | 2.3 | 1.8 | | |
| | | $I_{OH}$ = −18 mA | 2.3 | 1.7 | | |
| | | $I_{OH}$ = −100 µA | 1.65 - 2.3 | $V_{CC}$ - 0.2 | | |
| | | $I_{OH}$ = − 6 mA | 1.65 | 1.25 | | |
| | | $I_{OH}$ = −100µA | 1.4 - 1.6 | $V_{CC}$ - 0.2 | | |
| | | $I_{OH}$ = −2 mA | 1.4 | 1.05 | | |

## DC Electrical Characteristics (Continued)

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | Min | Max | Units |
|---|---|---|---|---|---|---|
| $V_{OL}$ | 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 | |
| | | $I_{OL}$ = 100 μA | 2.3 - 2.7 | | 0.2 | |
| | | $I_{OL}$ = 12 mA | 2.3 | | 0.4 | |
| | | $I_{OL}$ = 18 mA | 2.3 | | 0.6 | |
| | | $I_{OL}$ = 100 μA | 1.65 - 2.3 | | 0.2 | |
| | | $I_{OL}$ = 6 mA | 1.65 | | 0.3 | |
| | | $I_{OL}$ = 100 μA | 1.4 - 1.6 | | 0.2 | |
| | | $I_{OL}$ = 2 mA | 1.4 | | 0.35 | |
| $I_I$ | Input Leakage Current | $0 \le V_I \le 3.6V$ | 1.4 - 3.6 | | ±5.0 | μA |
| $I_{OZ}$ | 3-STATE Output Leakage | $0 \le V_O \le 3.6V$<br>$V_I = V_{IH}$ or $V_{IL}$ | 1.4 - 3.6 | | ±10.0 | μA |
| $I_{OFF}$ | Power Off Leakage Current | $0 \le (V_I, V_O) \le 3.6V$ | 0 | | 10.0 | μA |
| $I_{CC}$ | Quiescent Supply Current | $V_I = V_{CC}$ or GND | 1.4 - 3.6 | | 20.0 | μA |
| | | $V_{CC} \le V_I \le 3.6V$ | 1.4 - 3.6 | | ±20.0 | |
| $\Delta I_{CC}$ | Increase in $I_{CC}$ per Input | $V_{IH} = V_{CC}$ - 0.6V | 2.7 - 3.6 | | 750 | μA |

## AC Electrical Characteristics (Note 5)

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | $T_A = -40°C$ to $+85°C$ | | Units | Figure Number |
|---|---|---|---|---|---|---|---|
| | | | | Min | Max | | |
| $t_{PHL}$<br>$t_{PLH}$ | Propagation Delay | $C_L$ = 30 pF, $R_L$ = 500Ω | 3.3 ± 0.3 | 0.6 | 3.3 | ns | Figures 1, 2 |
| | | | 2.5 ± 0.2 | 0.8 | 4.1 | | |
| | | | 1.8 ± 0.15 | 1.0 | 8.2 | | |
| | | $C_L$ = 15 pF, $R_L$ = 2kΩ | 1.5 ± 0.1 | 1.0 | 16.4 | | Figures 3, 4 |
| $t_{OSHL}$<br>$t_{OSLH}$ | Output-to-Output Skew (Note 6) | $C_L$ = 30 pF, $R_L$ = 500Ω | 3.3 ± 0.3 | | 0.5 | ns | |
| | | | 2.5 ± 0.2 | | 0.5 | | |
| | | | 1.8 ± 0.15 | | 0.75 | | |
| | | $C_L$ = 15 pF, $R_L$ = 2kΩ | 1.5 ± 0.1 | | 1.5 | | |

**Note 5:** For $C_L$ = 50 pF, add approximately 300 ps to the AC maximum specification.

**Note 6:** 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 | 6.0 | pF |
| $C_{OUT}$ | Output Capacitance | $V_I$ = 0V or $V_{CC}$, $V_{CC}$ = 1.8V, 2.5V or 3.3V | 7.0 | pF |
| $C_{PD}$ | Power Dissipation Capacitance | $V_I$ = 0V or $V_{CC}$, f = 10MHz, $V_{CC}$ = 1.8V, 2.5V or 3.3V | 20.0 | pF |

## AC Loading and Waveforms ($V_{CC}$ 3.3V ± 0.3V to 1.8V ± 0.15V)

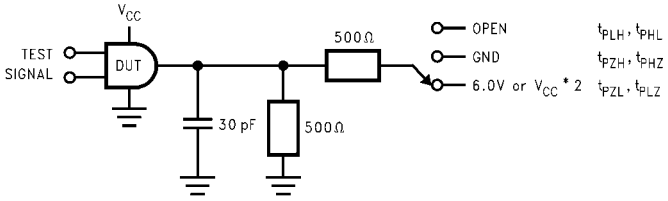



**FIGURE 1. AC Test Circuit**

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

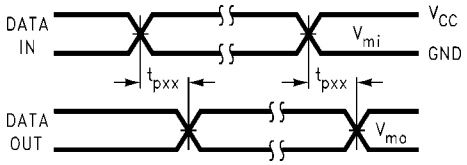
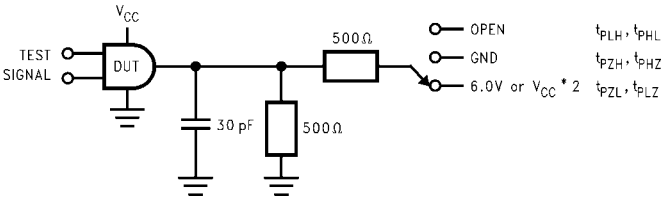



**FIGURE 2. Waveform for Inverting and Non-inverting Functions**

| 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 | $V_{CC}/2$ | $V_{CC}/2$ |

## AC Loading and Waveforms ($V_{CC}$ 1.5V ± 0.1V)




| TEST | SWITCH |
|---|---|
| $t_{PLH}$, $t_{PHL}$ | Open |
| $t_{PZL}$, $t_{PLZ}$ | $V_{CC}$ x 2 at $V_{CC}$ = 1.5V ± 0.1V |
| $t_{PZH}$, $t_{PHZ}$ | GND |

**FIGURE 3. AC Test Circuit**

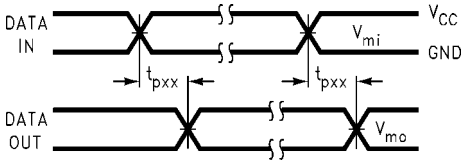



**FIGURE 4. Waveform for Inverting and Non-inverting Functions**

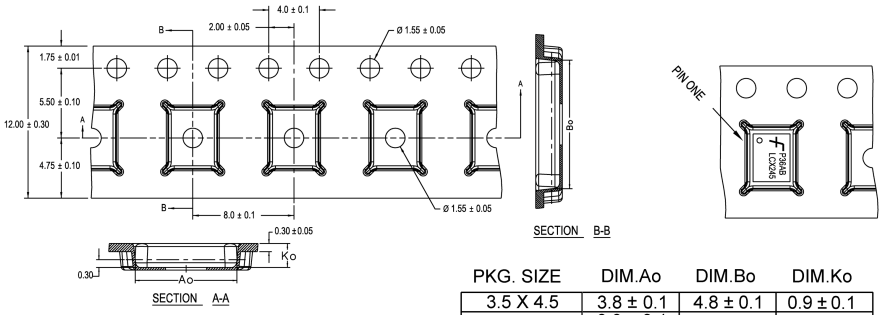
| Symbol | $V_{CC}$ |
|---|---|
| | **1.5V ± 0.1V** |
| $V_{mi}$ | $V_{CC}$/2 |
| $V_{mo}$ | $V_{CC}$/2 |

# Tape and Reel Specification

**Tape Format for DQFN**

| Package Designator | Tape Section | Number Cavities | Cavity Status | Cover Tape Status |
|---|---|---|---|---|
| BQX | Leader (Start End) | 125 (typ) | Empty | Sealed |
| | Carrier | 2500/3000 | Filled | Sealed |
| | Trailer (Hub End) | 75 (typ) | Empty | Sealed |

**TAPE DIMENSIONS** inches (millimeters)



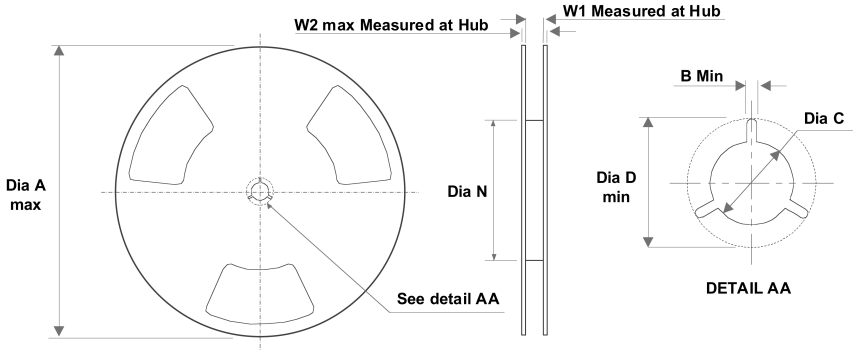

| PKG. SIZE | DIM.Ao | DIM.Bo | DIM.Ko |
|---|---|---|---|
| 3.5 X 4.5 | 3.8 ± 0.1 | 4.8 ± 0.1 | 0.9 ± 0.1 |
| 3.0 X 3.0 | 3.3 ± 0.1 | 3.3 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 4.5 | 2.8 ± 0.1 | 4.8 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 3.5 | 2.8 ± 0.1 | 3.8 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 3.0 | 2.8 ± 0.1 | 3.3 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 2.5 | 2.8 ± 0.1 | 2.8 ± 0.1 | 0.9 ± 0.1 |

DIMENSIONS ARE IN MILLIMETERS

NOTES: unless otherwise specified

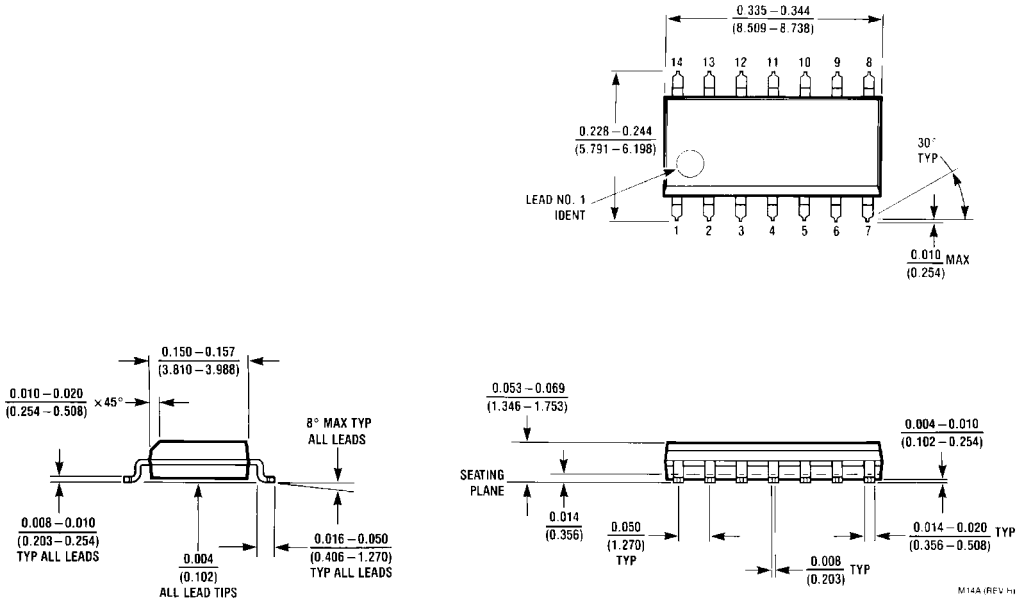
1. Cummulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is ±0.002[0.05] for these dimensions on all 12mm tapes.
5. Ao and Bo measured on a plane 0.120[0.30] above the bottom of the pocket.
6. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
7. Pocket position relative to sprocket hole measured as true position of pocket. Not pocket hole.
8. Controlling dimension is millimeter. Diemension in inches rounded.

**REEL DIMENSIONS** inches (millimeters)



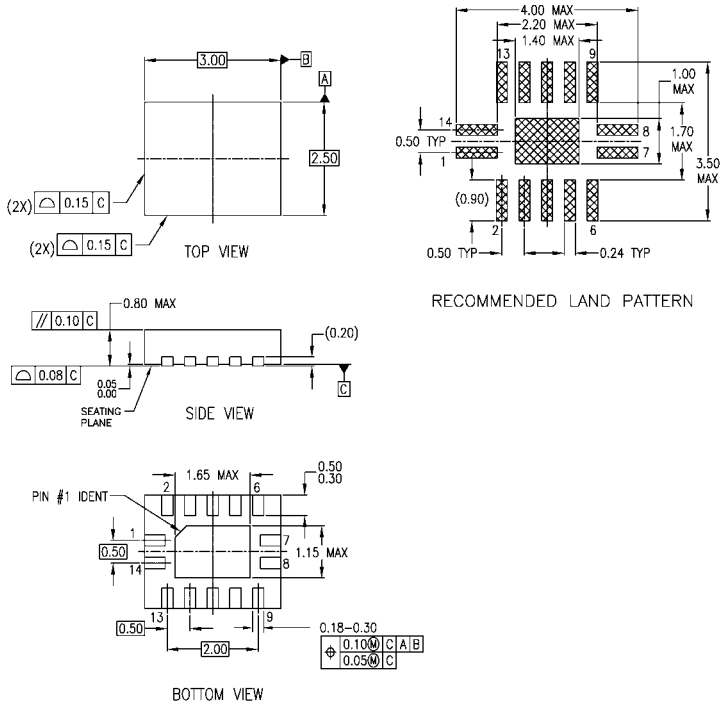

| Tape Size | A | B | C | D | N | W1 | W2 |
|---|---|---|---|---|---|---|---|
| 12 mm | 13.0 (330) | 0.059 (1.50) | 0.512 (13.00) | 0.795 (20.20) | 7.008 (178) | 0.488 (12.4) | 0.724 (18.4) |

## 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)



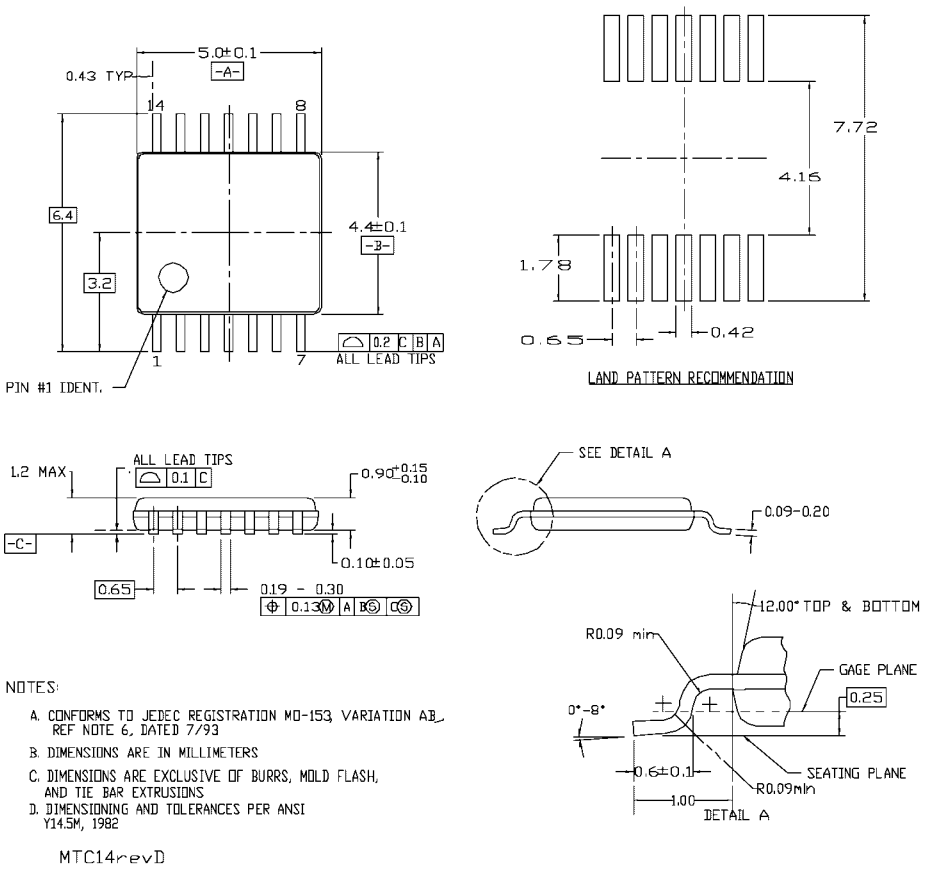

NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO–241, VARIATION AA
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP014ArevA

**Pb-Free 14-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.0mm**
**Package Number MLP014A**

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




NOTES:

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

B. DIMENSIONS ARE IN MILLIMETERS

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

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

MTC14revD

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

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