

## 74VCX00

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

### Features

- 1.2V to 3.6V  $V_{CC}$  supply operation
- 3.6V tolerant inputs and outputs
- $t_{PD}$ 
  - 2.8ns max. for 3.0V to 3.6V  $V_{CC}$
- Power-off high impedance inputs and outputs
- Static Drive ( $I_{OH}/I_{OL}$ )
  - $\pm 24mA$  @ 3.0V  $V_{CC}$
- Uses patented noise/EMI reduction circuitry
- Latchup performance exceeds JEDEC 78 conditions
- ESD performance:
  - Human body model > 2000V
  - Machine model > 250V
- Leadless DQFN package

### General Description

The VCX00 contains four 2-input NAND gates. This product is designed for low voltage (1.2V to 3.6V)  $V_{CC}$  applications with I/O compatibility up to 3.6V.

The VCX00 is fabricated with an advanced CMOS technology to achieve high-speed operation while maintaining low CMOS power dissipation.

### Ordering Information

| Order Number              | Package Number | Package Description                                                                         |
|---------------------------|----------------|---------------------------------------------------------------------------------------------|
| 74VCX00M                  | M14A           | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow                |
| 74VCX00BQX <sup>(1)</sup> | MLP14A         | 14-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.0mm |
| 74VCX00MTC                | MTC14          | 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide                 |

#### Note:

1. DQFN package available in Tape and Reel only.

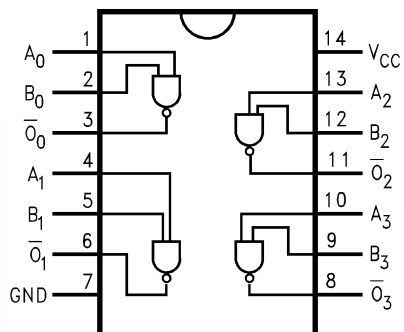
Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering number.



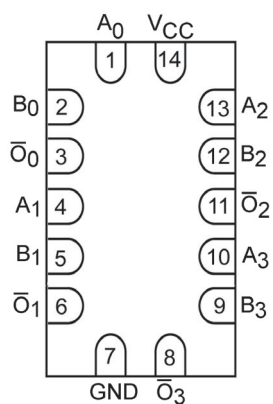
All packages are lead free per JEDEC: J-STD-020B standard.

## Connection Diagrams

Pin Assignments for SOIC and TSSOP



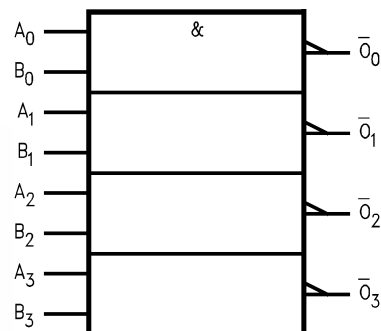
Pad Assignments for DQFN



(Top View)

## Logic Symbol

IEEE/IEC



## Pin Description

| Pin Names   | Description |
|-------------|-------------|
| $A_n, B_n$  | Inputs      |
| $\bar{O}_n$ | Outputs     |

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

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

**Note:**

2.  $I_O$  Absolute Maximum Rating must be observed.

## Recommended Operating Conditions<sup>(3)</sup>

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

| Symbol                | Parameter                                                         | Rating         |
|-----------------------|-------------------------------------------------------------------|----------------|
| $V_{CC}$              | Power Supply Operating                                            | 1.2V to 3.6V   |
| $V_I$                 | Input Voltage                                                     | −0.3V to 3.6V  |
| $V_O$                 | Output Voltage, HIGH or LOW State                                 | 0V to $V_{CC}$ |
| $I_{OH} / I_{OL}$     | Output Current<br>$V_{CC} = 3.0V$ to 3.6V                         | ±24mA          |
|                       | $V_{CC} = 2.3V$ to 2.7V                                           | ±18mA          |
|                       | $V_{CC} = 1.65V$ to 2.3V                                          | ±6mA           |
|                       | $V_{CC} = 1.4V$ to 1.6V                                           | ±2mA           |
|                       | $V_{CC} = 1.2V$                                                   | ± 100μA        |
| $T_A$                 | Free Air Operating Temperature                                    | −40°C to +85°C |
| $\Delta t / \Delta V$ | Minimum Input Edge Rate, $V_{IN} = 0.8V$ to 2.0V, $V_{CC} = 3.0V$ | 10ns/V         |

**Note:**

3. Floating or unused inputs must be held HIGH or LOW

## DC Electrical Characteristics

| Symbol           | Parameter                             | V <sub>CC</sub> (V) | Conditions                                                                        | Min                   | Max                  | Units |
|------------------|---------------------------------------|---------------------|-----------------------------------------------------------------------------------|-----------------------|----------------------|-------|
| V <sub>IH</sub>  | HIGH Level Input Voltage              | 2.7–3.6             |                                                                                   | 2.0                   |                      | V     |
|                  |                                       | 2.3–2.7             |                                                                                   | 1.6                   |                      |       |
|                  |                                       | 1.65–2.3            |                                                                                   | $0.65 \times V_{CC}$  |                      |       |
|                  |                                       | 1.4–1.6             |                                                                                   | $0.65 \times V_{CC}$  |                      |       |
|                  |                                       | 1.2                 |                                                                                   | $0.65 \times V_{CC}$  |                      |       |
| V <sub>IL</sub>  | LOW Level Input Voltage               | 2.7–3.6             |                                                                                   |                       | 0.8                  | V     |
|                  |                                       | 2.3–2.7             |                                                                                   |                       | 0.7                  |       |
|                  |                                       | 1.65–2.3            |                                                                                   |                       | $0.35 \times V_{CC}$ |       |
|                  |                                       | 1.4–1.6             |                                                                                   |                       | $0.35 \times V_{CC}$ |       |
|                  |                                       | 1.2                 |                                                                                   |                       | $0.05 \times V_{CC}$ |       |
| V <sub>OH</sub>  | HIGH Level Output Voltage             | 2.7–3.6             | I <sub>OH</sub> = –100μA                                                          | V <sub>CC</sub> – 0.2 |                      | V     |
|                  |                                       | 2.7                 | I <sub>OH</sub> = –12mA                                                           | 2.2                   |                      |       |
|                  |                                       | 3.0                 | I <sub>OH</sub> = –18mA                                                           | 2.4                   |                      |       |
|                  |                                       | 3.0                 | I <sub>OH</sub> = –24mA                                                           | 2.2                   |                      |       |
|                  |                                       | 2.3–2.7             | I <sub>OH</sub> = –100μA                                                          | V <sub>CC</sub> – 0.2 |                      |       |
|                  |                                       | 2.3                 | I <sub>OH</sub> = –6mA                                                            | 2.0                   |                      |       |
|                  |                                       | 2.3                 | I <sub>OH</sub> = –12mA                                                           | 1.8                   |                      |       |
|                  |                                       | 2.3                 | I <sub>OH</sub> = –18mA                                                           | 1.7                   |                      |       |
|                  |                                       | 1.65–2.3            | I <sub>OH</sub> = –100μA                                                          | V <sub>CC</sub> – 0.2 |                      |       |
|                  |                                       | 1.65                | I <sub>OH</sub> = –6mA                                                            | 1.25                  |                      |       |
|                  |                                       | 1.4–1.6             | I <sub>OH</sub> = –100μA                                                          | V <sub>CC</sub> – 0.2 |                      |       |
|                  |                                       | 1.4                 | I <sub>OH</sub> = –2mA                                                            | 1.05                  |                      |       |
|                  |                                       | 1.2                 | I <sub>OH</sub> = –100μA                                                          | V <sub>CC</sub> – 0.2 |                      |       |
| V <sub>OL</sub>  | LOW Level Output Voltage              | 2.7–3.6             | I <sub>OL</sub> = 100μA                                                           |                       | 0.2                  | V     |
|                  |                                       | 2.7                 | I <sub>OL</sub> = 12mA                                                            |                       | 0.4                  |       |
|                  |                                       | 3.0                 | I <sub>OL</sub> = 18mA                                                            |                       | 0.4                  |       |
|                  |                                       | 3.0                 | I <sub>OL</sub> = 24mA                                                            |                       | 0.55                 |       |
|                  |                                       | 2.3–2.7             | I <sub>OL</sub> = 100μA                                                           |                       | 0.2                  |       |
|                  |                                       | 2.3                 | I <sub>OL</sub> = 12mA                                                            |                       | 0.4                  |       |
|                  |                                       | 2.3                 | I <sub>OL</sub> = 18mA                                                            |                       | 0.6                  |       |
|                  |                                       | 1.65–2.3            | I <sub>OL</sub> = 100μA                                                           |                       | 0.2                  |       |
|                  |                                       | 1.65                | I <sub>OL</sub> = 6mA                                                             |                       | 0.3                  |       |
|                  |                                       | 1.4–1.6             | I <sub>OL</sub> = 100μA                                                           |                       | 0.2                  |       |
|                  |                                       | 1.4                 | I <sub>OL</sub> = 2mA                                                             |                       | 0.35                 |       |
|                  |                                       | 1.2                 | I <sub>OL</sub> = 100μA                                                           |                       | 0.05                 |       |
| I <sub>I</sub>   | Input Leakage Current                 | 1.4–3.6             | 0 ≤ V <sub>I</sub> ≤ 3.6V                                                         |                       | ±5.0                 | μA    |
| I <sub>OZ</sub>  | 3-STATE Output Leakage                | 1.4–3.6             | 0 ≤ V <sub>O</sub> ≤ 3.6V,<br>V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> |                       | ±10                  | μA    |
| I <sub>OFF</sub> | Power-OFF Leakage Current             | 0                   | 0 ≤ (V <sub>I</sub> , V <sub>O</sub> ) ≤ 3.6V                                     |                       | 10                   | μA    |
| I <sub>CC</sub>  | Quiescent Supply Current              | 1.4–3.6             | V <sub>I</sub> = V <sub>CC</sub> or GND                                           |                       | 20                   | μA    |
|                  |                                       |                     | V <sub>CC</sub> ≤ (V <sub>I</sub> , V <sub>O</sub> ) ≤ 3.6V <sup>(4)</sup>        |                       | ±20                  |       |
| ΔI <sub>CC</sub> | Increase in I <sub>CC</sub> per Input | 2.7–3.6             | V <sub>IH</sub> = V <sub>CC</sub> – 0.6V                                          |                       | 750                  | μA    |

**Note:**

4. Outputs disabled or 3-STATE only.

**AC Electrical Characteristics<sup>(5)</sup>**

| Symbol                                | Parameter                            | V <sub>CC</sub> (V) | Conditions                                   | T <sub>A</sub> = –40°C to +85°C |      | Units | Figure Number    |
|---------------------------------------|--------------------------------------|---------------------|----------------------------------------------|---------------------------------|------|-------|------------------|
|                                       |                                      |                     |                                              | Min.                            | Max. |       |                  |
| t <sub>PHL</sub> , t <sub>PLH</sub>   | Propagation Delay                    | 3.3 ± 0.3           | C <sub>L</sub> = 30pF, R <sub>L</sub> = 500Ω | 0.6                             | 2.8  | ns    | Fig. 1<br>Fig. 2 |
|                                       |                                      | 2.5 ± 0.2           |                                              | 0.8                             | 3.7  |       |                  |
|                                       |                                      | 1.8 ± 0.15          |                                              | 1.0                             | 7.4  |       |                  |
|                                       |                                      | 1.5 ± 0.1           | C <sub>L</sub> = 15pF, R <sub>L</sub> = 2kΩ  | 1.0                             | 14.8 |       | Fig. 3<br>Fig. 4 |
|                                       |                                      | 1.2                 |                                              | 1.5                             | 37.0 |       |                  |
| t <sub>OSHL</sub> , t <sub>OSLH</sub> | Output to Output Skew <sup>(6)</sup> | 3.3 ± 0.3           | C <sub>L</sub> = 30pF, R <sub>L</sub> = 500Ω |                                 | 0.5  | ns    |                  |
|                                       |                                      | 2.5 ± 0.2           |                                              |                                 | 0.5  |       |                  |
|                                       |                                      | 1.8 ± 0.15          |                                              |                                 | 0.75 |       |                  |
|                                       |                                      | 1.5 ± 0.1           | C <sub>L</sub> = 15pF, R <sub>L</sub> = 2kΩ  |                                 | 1.5  |       |                  |
|                                       |                                      | 1.2                 |                                              |                                 | 1.5  |       |                  |

**Note:**

5. For C<sub>L</sub> = 50pF, add approximately 300ps to the AC Maximum specification.

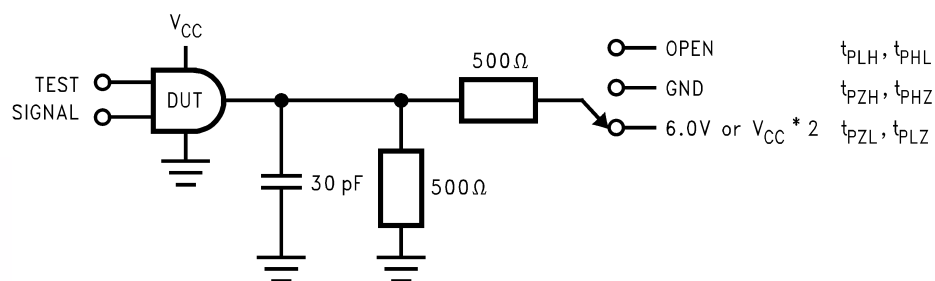
6. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t<sub>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>).

**Dynamic Switching Characteristics**

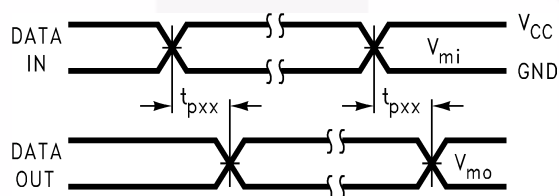
| Symbol           | Parameter                                   | V <sub>CC</sub> (V) | Conditions                                                                         | T <sub>A</sub> = 25°C | Unit |
|------------------|---------------------------------------------|---------------------|------------------------------------------------------------------------------------|-----------------------|------|
|                  |                                             |                     |                                                                                    | Typical               |      |
| V <sub>OLP</sub> | Quiet Output Dynamic Peak V <sub>OL</sub>   | 1.8                 | C <sub>L</sub> = 30pF, V <sub>IH</sub> = V <sub>CC</sub> ,<br>V <sub>IL</sub> = 0V | 0.25                  | V    |
|                  |                                             | 2.5                 |                                                                                    | 0.6                   |      |
|                  |                                             | 3.3                 |                                                                                    | 0.8                   |      |
| V <sub>OLV</sub> | Quiet Output Dynamic Valley V <sub>OL</sub> | 1.8                 | C <sub>L</sub> = 30pF, V <sub>IH</sub> = V <sub>CC</sub> ,<br>V <sub>IL</sub> = 0V | –0.25                 | V    |
|                  |                                             | 2.5                 |                                                                                    | –0.6                  |      |
|                  |                                             | 3.3                 |                                                                                    | –0.8                  |      |
| V <sub>OHV</sub> | Quiet Output Dynamic Valley V <sub>OH</sub> | 1.8                 | C <sub>L</sub> = 30pF, V <sub>IH</sub> = V <sub>CC</sub> ,<br>V <sub>IL</sub> = 0V | 1.5                   | V    |
|                  |                                             | 2.5                 |                                                                                    | 1.9                   |      |
|                  |                                             | 3.3                 |                                                                                    | 2.2                   |      |

**Capacitance**

| Symbol           | Parameter                     | Conditions                                                                                | T <sub>A</sub> = +25°C | Units |
|------------------|-------------------------------|-------------------------------------------------------------------------------------------|------------------------|-------|
|                  |                               |                                                                                           | Typical                |       |
| C <sub>IN</sub>  | Input Capacitance             | V <sub>I</sub> = 0V or V <sub>CC</sub> , V <sub>CC</sub> = 1.8V, 2.5V or 3.3V             | 6                      | pF    |
| C <sub>OUT</sub> | Output Capacitance            | V <sub>I</sub> = 0V or V <sub>CC</sub> , V <sub>CC</sub> = 1.8V, 2.5V or 3.3V             | 7                      | pF    |
| C <sub>PD</sub>  | Power Dissipation Capacitance | V <sub>I</sub> = 0V or V <sub>CC</sub> , f = 10 MHz, V <sub>CC</sub> = 1.8V, 2.5V or 3.3V | 20                     | pF    |

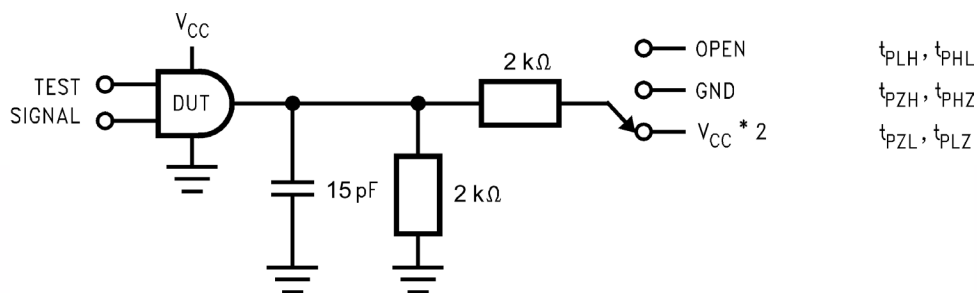
**AC Loading and Waveforms** ( $V_{CC}$  3.3V  $\pm$  0.3V to 1.8V  $\pm$  0.15V)

| Test               | Switch |
|--------------------|--------|
| $t_{PLH}, t_{PHL}$ | Open   |

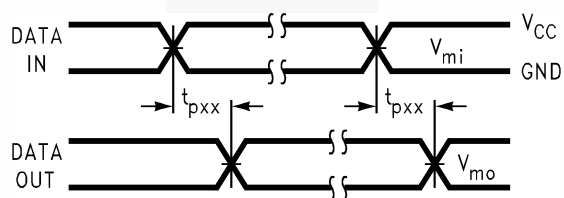
**Figure 1. AC Test Circuit**

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

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

**AC Loading and Waveforms** ( $V_{CC}$  1.5  $\pm$  0.1V to 1.2V)

| Test               | SWITCH                                        |
|--------------------|-----------------------------------------------|
| $t_{PLH}, t_{PHL}$ | Open                                          |
| $t_{PZL}, t_{PLZ}$ | $V_{CC} \times 2$ at $V_{CC} = 1.5V \pm 0.1V$ |
| $t_{PZH}, t_{PHZ}$ | GND                                           |

**Figure 3. AC Test Circuit**

| Symbol   | $V_{CC}$        |
|----------|-----------------|
|          | 1.5V $\pm$ 0.1V |
| $V_{mi}$ | $V_{CC} / 2$    |
| $V_{mo}$ | $V_{CC} / 2$    |

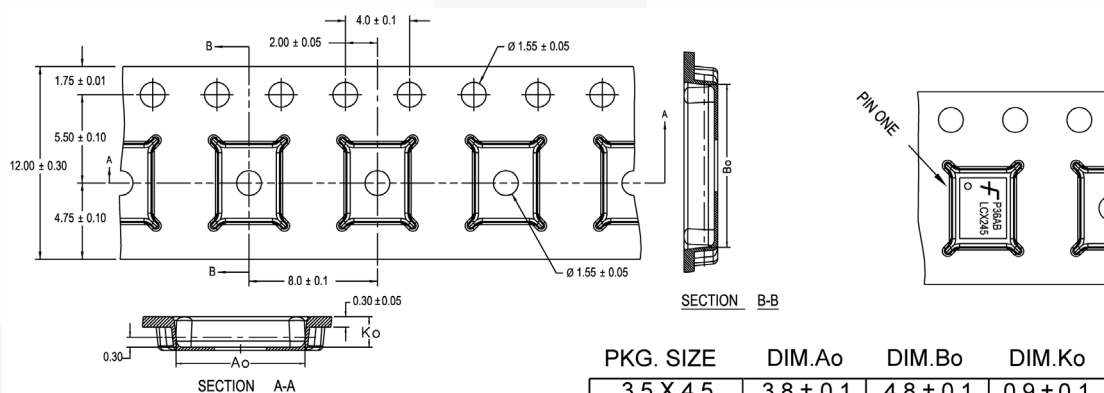
**Figure 4. Waveform for Inverting and Non-Inverting Functions**

## Tape and Reel Specification

### Tape Format for DQFN

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

### Tape Dimensions inches (millimeters)

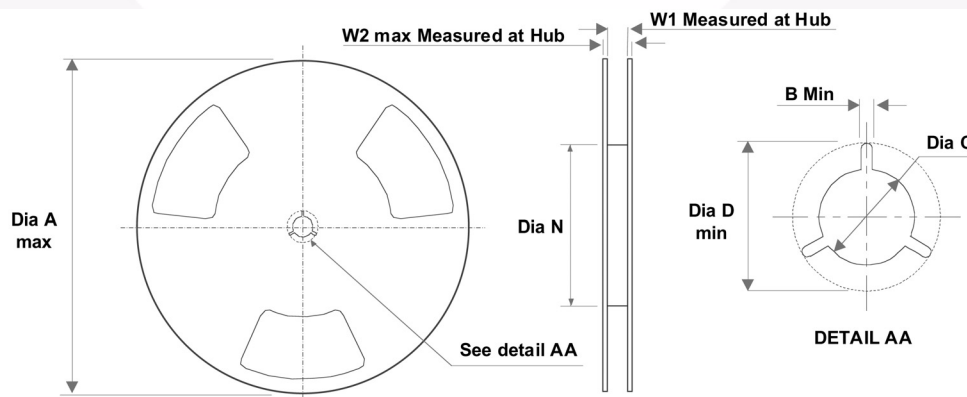


DIMENSIONS ARE IN MILLIMETERS

NOTES: unless otherwise specified

1. Cumulative 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  $\pm 0.002[0.05]$  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. Dimension in inches rounded.

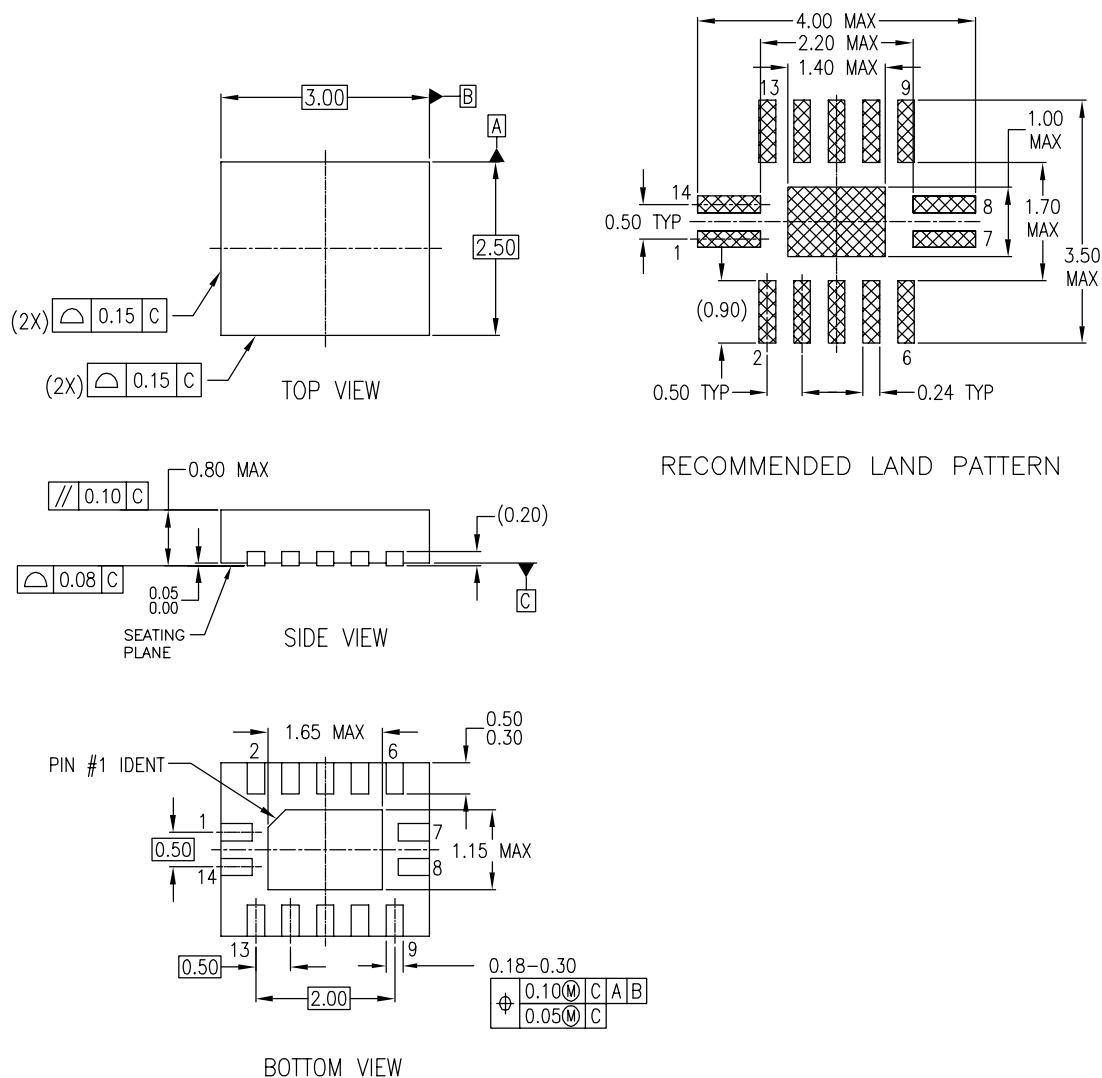
### Reel Dimensions inches (millimeters)



| Tape Size | A            | B            | C             | D             | N             | W1           | W2           |
|-----------|--------------|--------------|---------------|---------------|---------------|--------------|--------------|
| 12mm      | 13.0 (330.0) | 0.059 (1.50) | 0.512 (13.00) | 0.795 (20.20) | 2.165 (55.00) | 0.488 (12.4) | 0.724 (18.4) |



## Physical Dimensions (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

MLP14ArevA

**Figure 6. 14-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.0mm**

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

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| Build it Now <sup>™</sup>                                                         | FRFET <sup>®</sup>                           | Power220 <sup>®</sup>                  | SyncFET <sup>™</sup>             |
| CorePLUS <sup>™</sup>                                                             | Global Power Resource <sup>SM</sup>          | POWEREDGE <sup>®</sup>                 | SYSTEM <sup>®</sup>              |
| CROSSVOLT <sup>™</sup>                                                            | Green FPS <sup>™</sup>                       | Power-SPM <sup>™</sup>                 | GENERAL                          |
| CTL <sup>™</sup>                                                                  | Green FPS <sup>™</sup> e-Series <sup>™</sup> | PowerTrench <sup>®</sup>               | The Power Franchise <sup>®</sup> |
| Current Transfer Logic <sup>™</sup>                                               | GTO <sup>™</sup>                             | Programmable Active Droop <sup>™</sup> | the                              |
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|  | ISOPLANAR <sup>™</sup>                       | QT Optoelectronics <sup>™</sup>        | TinyBoost <sup>™</sup>           |
|  | MegaBuck <sup>™</sup>                        | Quiet Series <sup>™</sup>              | TinyBuck <sup>™</sup>            |
| Fairchild <sup>®</sup>                                                            | MICROCOUPLER <sup>™</sup>                    | RapidConfigure <sup>™</sup>            | TinyLogic <sup>®</sup>           |
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| FACT Quiet Series <sup>™</sup>                                                    | MicroPak <sup>™</sup>                        | SPM <sup>®</sup>                       | TinyPower <sup>™</sup>           |
| FACT <sup>®</sup>                                                                 | MillerDrive <sup>™</sup>                     | STEALTH <sup>™</sup>                   | TinyPWM <sup>™</sup>             |
| FAST <sup>®</sup>                                                                 | Motion-SPM <sup>™</sup>                      | SuperFET <sup>™</sup>                  | TinyWire <sup>™</sup>            |
| FastvCore <sup>™</sup>                                                            | OPTOLOGIC <sup>®</sup>                       | SuperSOT <sup>™</sup> 3                | µSerDes <sup>™</sup>             |
| FlashWriter <sup>®</sup> *                                                        | OPTOPLANAR <sup>®</sup>                      | SuperSOT <sup>™</sup> 6                | UHC <sup>®</sup>                 |
|                                                                                   |                                              | SuperSOT <sup>™</sup> 8                | Ultra FRFET <sup>™</sup>         |
|                                                                                   |                                              |                                        | UniFET <sup>™</sup>              |
|                                                                                   |                                              |                                        | VCX <sup>™</sup>                 |

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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 (c) 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 of the user.
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## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status         | Definition                                                                                                                                                                                               |
|--------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advance Information      | Formative or In Design | This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.                                                                       |
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