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## NC7WP08 TinyLogic® ULP Dual 2-Input AND Gate

### General Description

The NC7WP08 is a dual 2-input AND Gate from Fairchild's Ultra Low Power (ULP) Series of TinyLogic®. Ideal for applications where battery life is critical, this product is designed for ultra low power consumption within the  $V_{CC}$  operating range of 0.9V to 3.6V  $V_{CC}$ .

The internal circuit is composed of a minimum of inverter stages including the output buffer, to enable ultra low static and dynamic power.

The NC7WP08 is designed for optimized power and speed, and is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining extremely low CMOS power dissipation.

### Features

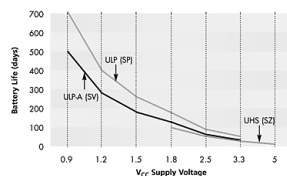
- Space saving US8 package
- Ultra small MicroPak™ Pb-Free package
- 0.9V to 3.6V  $V_{CC}$  supply operation
- 3.6V overvoltage tolerant I/O's at  $V_{CC}$  from 0.9V to 3.6V
- $t_{PD}$ 
  - 2.5 ns typ for 3.0V to 3.6V  $V_{CC}$
  - 5.0 ns typ for 2.3V to 2.7V  $V_{CC}$
  - 6.0 ns typ for 1.65V to 1.95V  $V_{CC}$
  - 7.0 ns typ for 1.40V to 1.60V  $V_{CC}$
  - 11.0 ns typ for 1.10V to 1.30V  $V_{CC}$
  - 27.0 ns typ for 0.90V  $V_{CC}$
- Power-Off high impedance inputs and outputs
- Static Drive ( $I_{OH}/I_{OL}$ )
  - ±2.6 mA @ 3.00V  $V_{CC}$
  - ±2.1 mA @ 2.30V  $V_{CC}$
  - ±1.5 mA @ 1.65V  $V_{CC}$
  - ±1.0 mA @ 1.40V  $V_{CC}$
  - ±0.5 mA @ 1.10V  $V_{CC}$
  - ±20  $\mu A$  @ 0.9V  $V_{CC}$
- Low noise switching using design techniques of Quiet Series™ noise/EMI reduction circuitry
- Ultra low dynamic power

### Ordering Code:

| Order Number | Package Number | Product Code Top Mark | Package Description                               | Supplied As               |
|--------------|----------------|-----------------------|---------------------------------------------------|---------------------------|
| NC7WP08K8X   | MAB08A         | WP08                  | 8-Lead US8, JEDEC MO-187, Variation CA 3.1mm Wide | 3k Units on Tape and Reel |
| NC7WP08L8X   | MAC08A         | Y5                    | Pb-Free 8-Lead MicroPak, 1.6 mm Wide              | 5k Units on Tape and Reel |

Pb-Free package per JEDEC J-STD-020B.

### Battery Life vs. $V_{CC}$ Supply Voltage



TinyLogic ULP and ULP-A with up to 50% less power consumption can extend your battery life significantly.

$$\text{Battery Life} = (V_{\text{battery}} * I_{\text{battery}} * 9) / (P_{\text{device}}) / 24\text{hrs/day}$$

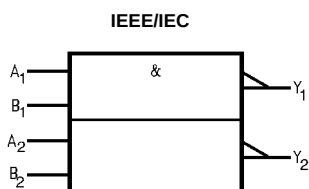
$$\text{Where, } P_{\text{device}} = (I_{CC} * V_{CC}) + (C_{PD} + C_L) * V_{CC}^2 * f$$

Assumes ideal 3.6V Lithium Ion battery with current rating of 900mAh and derated 90% and device frequency at 10MHz, with  $C_L = 15$  pF load

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MicroPak™ and Quiet Series™ are trademarks of Fairchild Semiconductor Corporation.

## Logic Symbol



## Pin Descriptions

| Pin Names  | Description |
|------------|-------------|
| $A_n, B_n$ | Input       |
| $Y_n$      | Output      |

## Function Table

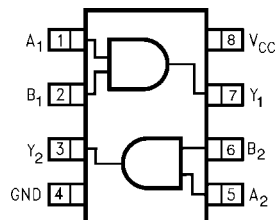
$$Y = AB$$

| Inputs |   | Output |
|--------|---|--------|
| A      | B | Y      |
| L      | L | L      |
| L      | H | L      |
| H      | L | L      |
| H      | H | H      |

H = HIGH Logic Level  
L = LOW Logic Level

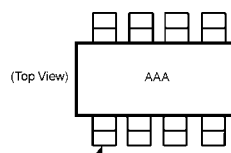
## Connection Diagrams

### Pin Assignments for US8



(Top View)

### Pin One Orientation Diagram

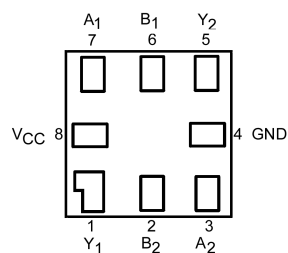


Pin One

AAA represents Product Code Top Mark - see ordering code

**Note:** Orientation of Top Mark determines Pin One location. Read the top product code mark left to right, Pin One is the lower left pin (see diagram).

### Pad Assignments for MicroPak



(Top Thru View)

**Absolute Maximum Ratings**(Note 1)

|                                                   |                         |
|---------------------------------------------------|-------------------------|
| Supply Voltage ( $V_{CC}$ )                       | -0.5V to +4.6V          |
| DC Input Voltage ( $V_{IN}$ )                     | -0.5V to +4.6V          |
| DC Output Voltage ( $V_{OUT}$ )                   |                         |
| 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 ( $I_{IK}$ ) $V_{IN} < 0V$ | $\pm 50$ mA             |
| DC Output Diode Current ( $I_{OK}$ )              |                         |
| $V_{OUT} < 0V$                                    | -50 mA                  |
| $V_{OUT} > V_{CC}$                                | +50 mA                  |
| DC Output Source/Sink Current ( $I_{OH}/I_{OL}$ ) | $\pm 50$ mA             |
| DC $V_{CC}$ or Ground Current per                 |                         |
| Supply Pin ( $I_{CC}$ or Ground)                  | $\pm 50$ mA             |
| Storage Temperature Range ( $T_{STG}$ )           | -65°C to +150°C         |

**Recommended Operating Conditions** (Note 3)

|                                                 |                  |
|-------------------------------------------------|------------------|
| Supply Voltage                                  | 0.9V to 3.6V     |
| Input Voltage ( $V_{IN}$ )                      | 0V to 3.6V       |
| Output Voltage ( $V_{OUT}$ )                    |                  |
| HIGH or LOW State                               | 0V to $V_{CC}$   |
| $V_{CC} = 0V$                                   | 0V to 3.6V       |
| Output Current in $I_{OH}/I_{OL}$               |                  |
| $V_{CC} = 3.0V$ to 3.6V                         | $\pm 2.6$ mA     |
| $V_{CC} = 2.3V$ to 2.7V                         | $\pm 2.1$ mA     |
| $V_{CC} = 1.65V$ to 1.95V                       | $\pm 1.5$ mA     |
| $V_{CC} = 1.40V$ to 1.60V                       | $\pm 1.0$ mA     |
| $V_{CC} = 1.10V$ to 1.30V                       | $\pm 0.5$ mA     |
| $V_{CC} = 0.9V$                                 | $\pm 20$ $\mu$ A |
| Free Air Operating Temperature ( $T_A$ )        | -40°C to +85°C   |
| Minimum Input Edge Rate ( $\Delta t/\Delta V$ ) |                  |
| $V_{IN} = 0.8V$ to 2.0V, $V_{CC} = 3.0V$        | 10 ns/V          |

**Note 1:** 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:** Unused inputs must be held HIGH or LOW. They may not float.

**DC Electrical Characteristics**

| Symbol   | Parameter                    | $V_{CC}$<br>(V)              | $T_A = +25^\circ\text{C}$ |                 | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ |                 | Units | Conditions                 |
|----------|------------------------------|------------------------------|---------------------------|-----------------|--------------------------------------------------|-----------------|-------|----------------------------|
|          |                              |                              | Min                       | Max             | Min                                              | Max             |       |                            |
| $V_{IH}$ | HIGH Level<br>Input Voltage  | 0.90                         | 0.65 x $V_{CC}$           |                 | 0.65 x $V_{CC}$                                  |                 | V     |                            |
|          |                              | $1.10 \leq V_{CC} \leq 1.30$ | 0.65 x $V_{CC}$           |                 | 0.65 x $V_{CC}$                                  |                 |       |                            |
|          |                              | $1.40 \leq V_{CC} \leq 1.60$ | 0.65 x $V_{CC}$           |                 | 0.65 x $V_{CC}$                                  |                 |       |                            |
|          |                              | $1.65 \leq V_{CC} \leq 1.95$ | 0.65 x $V_{CC}$           |                 | 0.65 x $V_{CC}$                                  |                 |       |                            |
|          |                              | $2.30 \leq V_{CC} \leq 2.70$ | 1.6                       |                 | 1.6                                              |                 |       |                            |
|          |                              | $3.00 \leq V_{CC} \leq 3.60$ | 2.1                       |                 | 2.1                                              |                 |       |                            |
| $V_{IL}$ | LOW Level<br>Input Voltage   | 0.90                         |                           | 0.35 x $V_{CC}$ |                                                  | 0.35 x $V_{CC}$ | V     |                            |
|          |                              | $1.10 \leq V_{CC} \leq 1.30$ |                           | 0.35 x $V_{CC}$ |                                                  | 0.35 x $V_{CC}$ |       |                            |
|          |                              | $1.40 \leq V_{CC} \leq 1.60$ |                           | 0.35 x $V_{CC}$ |                                                  | 0.35 x $V_{CC}$ |       |                            |
|          |                              | $1.65 \leq V_{CC} \leq 1.95$ |                           | 0.35 x $V_{CC}$ |                                                  | 0.35 x $V_{CC}$ |       |                            |
|          |                              | $2.30 \leq V_{CC} \leq 2.70$ |                           | 0.7             |                                                  | 0.7             |       |                            |
|          |                              | $3.00 \leq V_{CC} \leq 3.60$ |                           | 0.9             |                                                  | 0.9             |       |                            |
| $V_{OH}$ | HIGH Level<br>Output Voltage | 0.90                         | $V_{CC} - 0.1$            |                 | $V_{CC} - 0.1$                                   |                 | V     | $I_{OH} = -20 \mu\text{A}$ |
|          |                              | $1.10 \leq V_{CC} \leq 1.30$ | $V_{CC} - 0.1$            |                 | $V_{CC} - 0.1$                                   |                 |       |                            |
|          |                              | $1.40 \leq V_{CC} \leq 1.60$ | $V_{CC} - 0.1$            |                 | $V_{CC} - 0.1$                                   |                 |       |                            |
|          |                              | $1.65 \leq V_{CC} \leq 1.95$ | $V_{CC} - 0.1$            |                 | $V_{CC} - 0.1$                                   |                 |       |                            |
|          |                              | $2.30 \leq V_{CC} \leq 2.70$ | $V_{CC} - 0.1$            |                 | $V_{CC} - 0.1$                                   |                 |       |                            |
|          |                              | $3.00 \leq V_{CC} \leq 3.60$ | $V_{CC} - 0.1$            |                 | $V_{CC} - 0.1$                                   |                 |       |                            |
|          |                              | $1.10 \leq V_{CC} \leq 1.30$ | 0.75 x $V_{CC}$           |                 | 0.70 x $V_{CC}$                                  |                 |       | $I_{OH} = -0.5 \text{ mA}$ |
|          |                              | $1.40 \leq V_{CC} \leq 1.60$ | 1.07                      |                 | 0.99                                             |                 |       | $I_{OH} = -1.0 \text{ mA}$ |
|          |                              | $1.65 \leq V_{CC} \leq 1.95$ | 1.24                      |                 | 1.22                                             |                 |       | $I_{OH} = -1.5 \text{ mA}$ |
|          |                              | $2.30 \leq V_{CC} \leq 2.70$ | 1.95                      |                 | 1.87                                             |                 |       | $I_{OH} = -2.1 \text{ mA}$ |
|          |                              | $3.00 \leq V_{CC} \leq 3.60$ | 2.61                      |                 | 2.55                                             |                 |       | $I_{OH} = -2.6 \text{ mA}$ |

## DC Electrical Characteristics (Continued)

| Symbol           | Parameter                   | V <sub>CC</sub><br>(V)        | T <sub>A</sub> = +25°C |     | T <sub>A</sub> = -40°C to +85°C |     | Units                    | Conditions                                    |
|------------------|-----------------------------|-------------------------------|------------------------|-----|---------------------------------|-----|--------------------------|-----------------------------------------------|
|                  |                             |                               | Min                    | Max | Min                             | Max |                          |                                               |
| V <sub>OL</sub>  | LOW Level<br>Output Voltage | 0.90                          |                        | 0.1 |                                 | 0.1 | V                        | I <sub>OL</sub> = 20 μA                       |
|                  |                             | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 |                        | 0.1 |                                 | 0.1 |                          |                                               |
|                  |                             | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 |                        | 0.1 |                                 | 0.1 |                          |                                               |
|                  |                             | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 |                        | 0.1 |                                 | 0.1 |                          |                                               |
|                  |                             | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 |                        | 0.1 |                                 | 0.1 |                          |                                               |
|                  |                             | 3.00 ≤ V <sub>CC</sub> ≤ 3.60 |                        | 0.1 |                                 | 0.1 |                          |                                               |
|                  |                             | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 0.30 x V <sub>CC</sub> |     | 0.30 x V <sub>CC</sub>          |     |                          | I <sub>OL</sub> = 0.5 mA                      |
|                  |                             | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 0.31                   |     | 0.37                            |     |                          | I <sub>OL</sub> = 1.0 mA                      |
|                  |                             | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 0.31                   |     | 0.35                            |     |                          | I <sub>OL</sub> = 1.5 mA                      |
|                  |                             | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 0.31                   |     | 0.33                            |     |                          | I <sub>OL</sub> = 2.1 mA                      |
|                  |                             | 3.00 ≤ V <sub>CC</sub> ≤ 3.60 | 0.31                   |     | 0.33                            |     | I <sub>OL</sub> = 2.6 mA |                                               |
| I <sub>IN</sub>  | Input Leakage Current       | 0.90 to 3.60                  | ±0.1                   |     | ±0.5                            |     | μA                       | 0 ≤ V <sub>I</sub> ≤ 3.6V                     |
| I <sub>OFF</sub> | Power Off Leakage Current   | 0                             | 0.5                    |     | 0.5                             |     | μA                       | 0 ≤ (V <sub>I</sub> , V <sub>O</sub> ) ≤ 3.6V |
| I <sub>CC</sub>  | Quiescent Supply Current    | 0.90 to 3.60                  | 0.9                    |     | 0.9                             |     | μA                       | V <sub>I</sub> = V <sub>CC</sub> or GND       |

## AC Electrical Characteristics

| Symbol                               | Parameter                     | V <sub>CC</sub><br>(V)        | T <sub>A</sub> = +25°C |      |      | T <sub>A</sub> = -40°C to +85°C |      | Units | Conditions                                             | Figure Number |
|--------------------------------------|-------------------------------|-------------------------------|------------------------|------|------|---------------------------------|------|-------|--------------------------------------------------------|---------------|
|                                      |                               |                               | Min                    | Typ  | Max  | Min                             | Max  |       |                                                        |               |
| t <sub>PHL</sub><br>t <sub>PLH</sub> | Propagation Delay             | 0.9                           |                        | 27.0 |      |                                 |      | ns    | C <sub>L</sub> = 10 pF<br>R <sub>L</sub> = 1 MΩ        | Figures 1, 2  |
|                                      |                               | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 3.5                    | 11.0 | 21.8 | 3.0                             | 34.3 |       |                                                        |               |
|                                      |                               | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 2.5                    | 7.0  | 14.8 | 2.0                             | 15.0 |       |                                                        |               |
|                                      |                               | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.0                    | 6.0  | 12.0 | 1.5                             | 12.2 |       |                                                        |               |
|                                      |                               | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 1.5                    | 5.0  | 9.4  | 1.0                             | 9.9  |       |                                                        |               |
| t <sub>PHL</sub><br>t <sub>PLH</sub> | Propagation Delay             | 0.90                          |                        | 30.0 |      |                                 |      | ns    | C <sub>L</sub> = 15 pF<br>R <sub>L</sub> = 1 MΩ        | Figures 1, 2  |
|                                      |                               | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 4.0                    | 11.0 | 22.8 | 3.5                             | 37.3 |       |                                                        |               |
|                                      |                               | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.0                    | 8.0  | 15.5 | 2.5                             | 16.5 |       |                                                        |               |
|                                      |                               | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.5                    | 6.0  | 12.6 | 2.0                             | 13.6 |       |                                                        |               |
|                                      |                               | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 2.0                    | 5.0  | 9.9  | 1.5                             | 10.8 |       |                                                        |               |
| t <sub>PHL</sub><br>t <sub>PLH</sub> | Propagation Delay             | 0.90                          |                        | 32.0 |      |                                 |      | ns    | C <sub>L</sub> = 30 pF<br>R <sub>L</sub> = 1 MΩ        | Figures 1, 2  |
|                                      |                               | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 5.0                    | 13.0 | 25.9 | 4.0                             | 46.3 |       |                                                        |               |
|                                      |                               | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 4.0                    | 9.0  | 17.8 | 3.5                             | 18.2 |       |                                                        |               |
|                                      |                               | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 3.0                    | 7.0  | 14.4 | 2.0                             | 15.9 |       |                                                        |               |
|                                      |                               | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 2.0                    | 6.0  | 11.3 | 1.5                             | 12.8 |       |                                                        |               |
| C <sub>IN</sub>                      | Input Capacitance             | 0                             | 2.0                    |      |      |                                 |      | pF    |                                                        |               |
| C <sub>OUT</sub>                     | Output Capacitance            | 0                             | 4.0                    |      |      |                                 |      | pF    |                                                        |               |
| C <sub>PD</sub>                      | Power Dissipation Capacitance | 0.9 to 3.60                   | 6.0                    |      |      |                                 |      | pF    | V <sub>I</sub> = 0V or V <sub>CC</sub> ,<br>f = 10 MHz |               |

# AC Loading and Waveforms

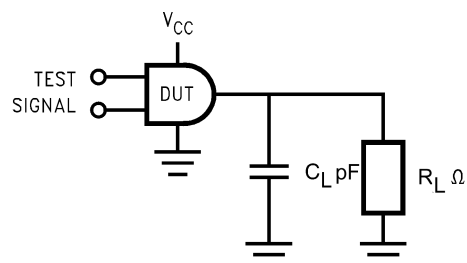


FIGURE 1. AC Test Circuit

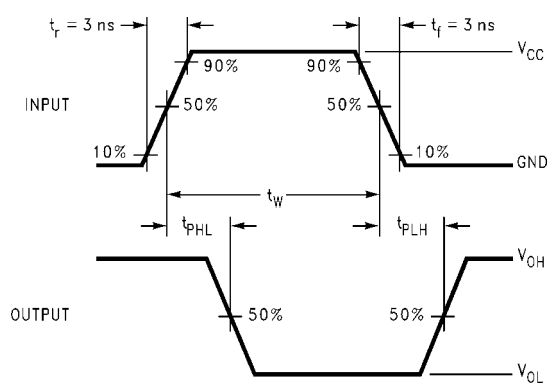


FIGURE 2. AC Waveforms

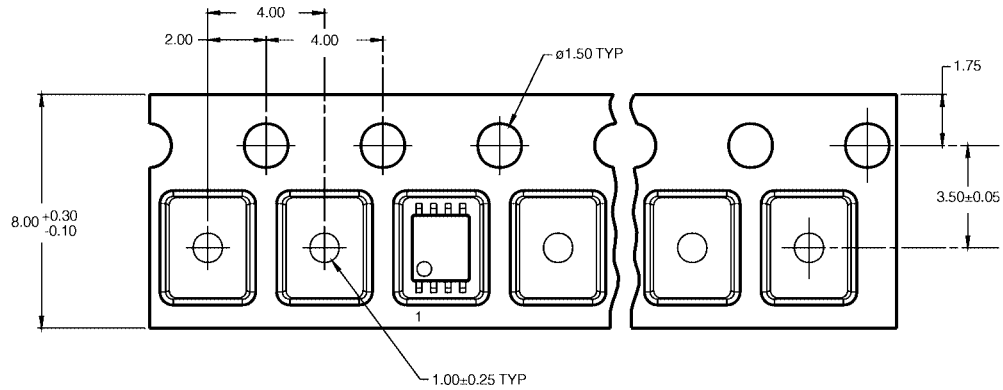
| Symbol   | $V_{CC}$        |                 |                  |                  |                  |            |
|----------|-----------------|-----------------|------------------|------------------|------------------|------------|
|          | $3.3V \pm 0.3V$ | $2.5V \pm 0.2V$ | $1.8V \pm 0.15V$ | $1.5V \pm 0.10V$ | $1.2V \pm 0.10V$ | $0.9V$     |
| $V_{mi}$ | 1.5V            | $V_{CC}/2$      | $V_{CC}/2$       | $V_{CC}/2$       | $V_{CC}/2$       | $V_{CC}/2$ |
| $V_{mo}$ | 1.5V            | $V_{CC}/2$      | $V_{CC}/2$       | $V_{CC}/2$       | $V_{CC}/2$       | $V_{CC}/2$ |

## Tape and Reel Specification

### TAPE FORMAT for US8

| Package Designator | Tape Section       | Number Cavities | Cavity Status | Cover Tape Status |
|--------------------|--------------------|-----------------|---------------|-------------------|
| K8X                | Leader (Start End) | 125 (typ)       | Empty         | Sealed            |
|                    | Carrier            | 3000            | Filled        | Sealed            |
|                    | Trailer (Hub End)  | 75 (typ)        | Empty         | Sealed            |

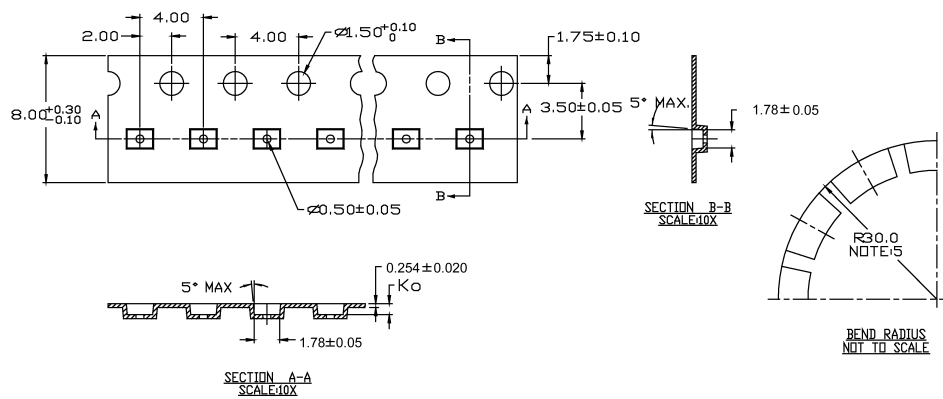
### TAPE DIMENSIONS inches (millimeters)



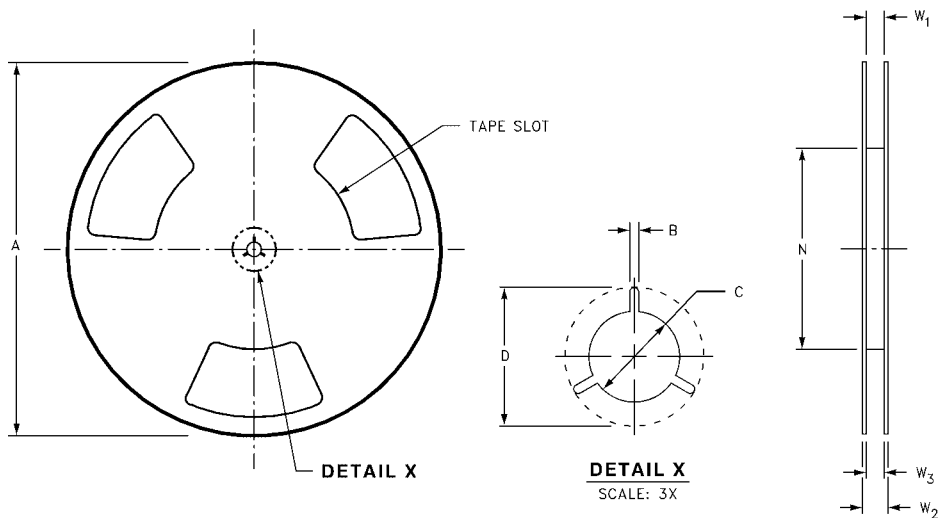
### TAPE FORMAT for MicroPak

| Package Designator | Tape Section       | Number Cavities | Cavity Status | Cover Tape Status |
|--------------------|--------------------|-----------------|---------------|-------------------|
| L8X                | Leader (Start End) | 125 (typ)       | Empty         | Sealed            |
|                    | Carrier            | 3000            | Filled        | Sealed            |
|                    | Trailer (Hub End)  | 75 (typ)        | Empty         | Sealed            |

### TAPE DIMENSIONS inches (millimeters)

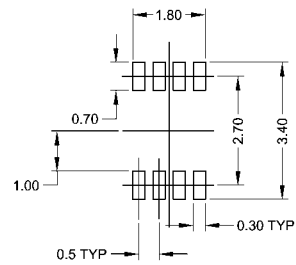


**Tape and Reel Specification** (Continued)  
**REEL DIMENSIONS** inches (millimeters)

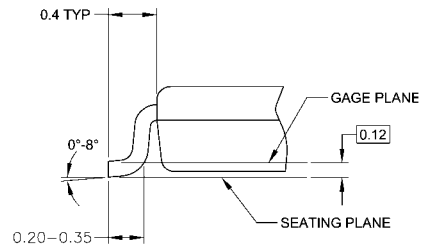
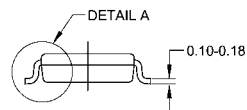


| Tape Size | A              | B               | C                | D                | N                | W1                                          | W2               | W3                                     |
|-----------|----------------|-----------------|------------------|------------------|------------------|---------------------------------------------|------------------|----------------------------------------|
| 8 mm      | 7.0<br>(177.8) | 0.059<br>(1.50) | 0.512<br>(13.00) | 0.795<br>(20.20) | 2.165<br>(55.00) | 0.331 + 0.059/-0.000<br>(8.40 + 1.50/-0.00) | 0.567<br>(14.40) | W1 + 0.078/-0.039<br>(W1 + 2.00/-1.00) |





### LAND PATTERN RECOMMENDATION

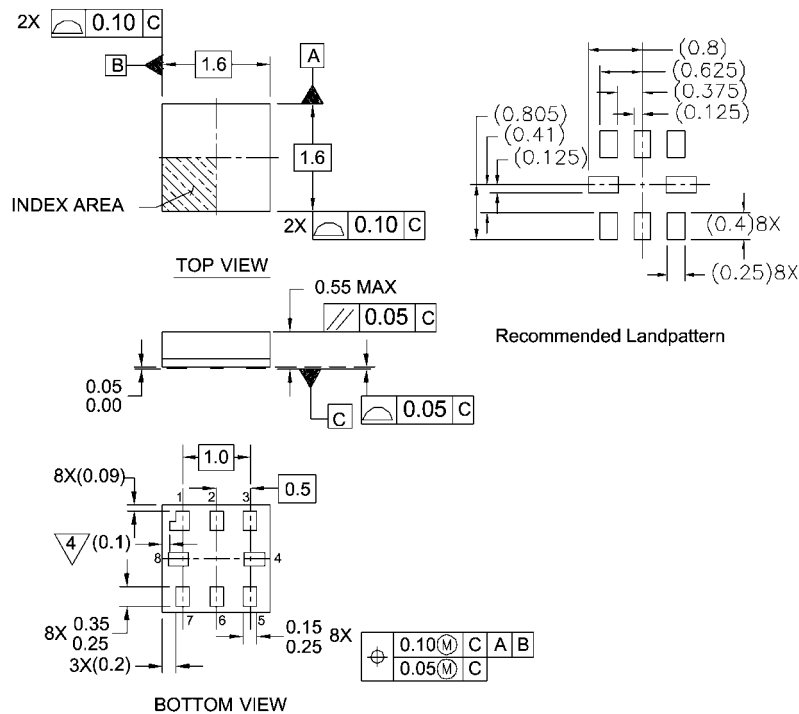


DETAIL A

A. CONFORMS TO JEDEC REGISTRATION MO-187  
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.

**8-Lead US8, JEDEC MO-187, Variation CA 3.1mm Wide  
Package Number MAB08A**

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



### Notes:

1. PACKAGE CONFORMS TO JEDEC MO-255 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y.14M-1994
4. PIN 1 FLAG, END OF PACKAGE OFFSET.

MAC08AREVC

**Pb-Free 8-Lead MicroPak, 1.6 mm Wide  
Package Number MAC08A**

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Телефон: 8 (812) 309-75-97 (многоканальный)

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Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

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Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А