

# TinyLogic UHS Dual 2-Input NAND Gate (Open Drain Output) NC7WZ38

## Description

The NC7WZ38 is a dual 2-Input NAND Gate with open drain output stage from ON Semiconductor's Ultra High Speed Series of TinyLogic. The device is fabricated with advanced CMOS technology to achieve ultra high speed with high output drive while maintaining low static power dissipation over a very broad  $V_{CC}$  operating range. The device is specified to operate over the 1.65 V to 5.5 V  $V_{CC}$  range. The inputs and output are high impedance when  $V_{CC}$  is 0 V. Inputs tolerate voltages up to 5.5 V independent of  $V_{CC}$  operating voltage. The open drain output stage will tolerate voltages up to 5.5 V independent of  $V_{CC}$  when in the high impedance state.

## Features

- Space Saving US8 Surface Mount Package
- MicroPak™ Pb-Free Leadless Package
- Open Drain Output Stage for OR Tied Applications
- Ultra High Speed:  $t_{PD}$  2.2 ns Typ. into 50 pF at 5 V  $V_{CC}$
- High Output Sink Drive:  $\pm 24$  mA at 3 V  $V_{CC}$
- Broad  $V_{CC}$  Operating Range: 1.65 V to 5.5 V
- Matches the Performance of LCX when Operated at 3.3 V  $V_{CC}$
- Power Down High Impedance Inputs / Output
- Overvoltage Tolerant Inputs Facilitate 5 V to 3 V Translation
- Patented Noise / EMI Reduction Circuitry Implemented
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

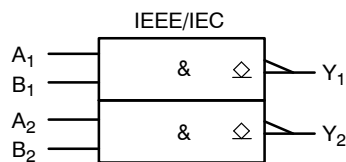
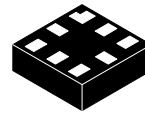
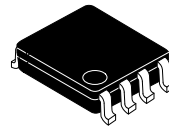


Figure 1. Logic Symbol

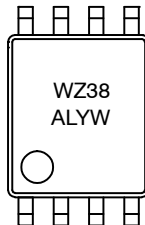
## MARKING DIAGRAMS



UQFN8  
1.6X1.6, 0.5P  
CASE 523AY



US8  
CASE 846AN



U5, WZ38 = Specific Device Code  
 KK = 2-Digit Lot Run Traceability Code  
 XY = 2-Digit Date Code Format  
 Z = Assembly Plant Code  
 A = Assembly Site  
 L = Wafer Lot Number  
 YW = Assembly Start Week

## ORDERING INFORMATION

See detailed ordering, marking and shipping information in the package dimensions section on page 5 of this data sheet.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 5.

## Connection Diagram

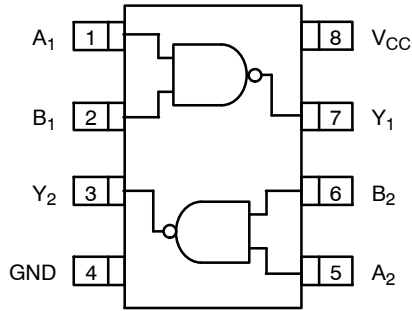


Figure 2. Connection Diagram (Top View)

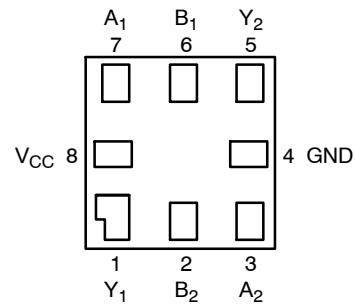
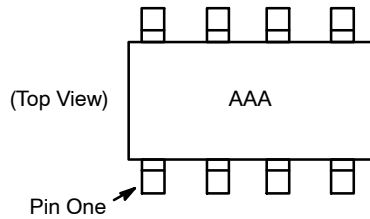


Figure 4. Pad Assignments for MicroPak (Top Thru View)



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).

Figure 3. Pin One Orientation Diagram

## PIN DESCRIPTIONS

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

## FUNCTION TABLE ( $Y = \overline{AB}$ )

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

H = HIGH Logic Level

L = LOW Logic Level

\*H = HIGH Impedance Output State (Open Drain)

## ABSOLUTE MAXIMUM RATINGS

| Symbol                             | Parameter                                         |                        | Min  | Max  | Unit |
|------------------------------------|---------------------------------------------------|------------------------|------|------|------|
| V <sub>CC</sub>                    | Supply Voltage                                    |                        | -0.5 | 6.5  | V    |
| V <sub>IN</sub>                    | DC Input Voltage                                  |                        | -0.5 | 6.5  | V    |
| V <sub>OUT</sub>                   | DC Output Voltage                                 |                        | -0.5 | 6.5  | V    |
| I <sub>IK</sub>                    | DC Input Diode Current                            | V <sub>IN</sub> < 0 V  | -    | -50  | mA   |
| I <sub>OK</sub>                    | DC Output Diode Current                           | V <sub>OUT</sub> < 0 V | -    | -50  | mA   |
| I <sub>OUT</sub>                   | DC Output Current                                 |                        | -    | ±50  | mA   |
| I <sub>CC</sub> / I <sub>GND</sub> | DC V <sub>CC</sub> / GND Current                  |                        | -    | ±100 | mA   |
| T <sub>STG</sub>                   | Storage Temperature                               |                        | -65  | +150 | °C   |
| T <sub>J</sub>                     | Junction Temperature under Bias                   |                        | -    | 150  | °C   |
| T <sub>L</sub>                     | Junction Lead Temperature (Soldering, 10 Seconds) |                        | -    | 260  | °C   |
| P <sub>D</sub>                     | Power Dissipation in Still Air                    |                        | -    | 500  | mW   |
|                                    |                                                   |                        | -    | 539  |      |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

## RECOMMENDED OPERATING CONDITIONS

| Symbol                          | Parameter                     |                                               | Min  | Max             | Unit |
|---------------------------------|-------------------------------|-----------------------------------------------|------|-----------------|------|
| V <sub>CC</sub>                 | Supply Voltage Operating      |                                               | 1.65 | 5.5             | V    |
|                                 | Supply Voltage Data Retention |                                               | 1.5  | 5.5             |      |
| V <sub>IN</sub>                 | Input Voltage                 |                                               | 0    | 5.5             | V    |
| V <sub>OUT</sub>                | Output Voltage                |                                               | 0    | V <sub>CC</sub> | V    |
| T <sub>A</sub>                  | Operating Temperature         |                                               | -40  | +85             | °C   |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise and Fall Time      | V <sub>CC</sub> = 1.8 V ±0.15 V, 2.5 V ±0.2 V | 0    | 20              | ns/V |
|                                 |                               | V <sub>CC</sub> = 3.3 V ±0.3 V                | 0    | 10              |      |
|                                 |                               | V <sub>CC</sub> = 5.0 V ±0.5 V                | 0    | 5               |      |
| θ <sub>JA</sub>                 | Thermal Resistance            |                                               | -    | 250             | °C/W |
|                                 |                               |                                               | -    | 232             |      |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

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

## DC ELECTRICAL CHARACTERISTICS

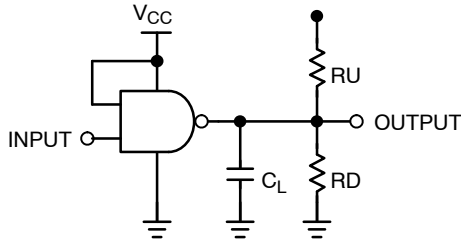
| Symbol           | Parameter                 | V <sub>CC</sub> (V) | Conditions                                                                     | T <sub>A</sub> = +25°C |      |                      | T <sub>A</sub> = -40 to +85°C |                      | Unit |
|------------------|---------------------------|---------------------|--------------------------------------------------------------------------------|------------------------|------|----------------------|-------------------------------|----------------------|------|
|                  |                           |                     |                                                                                | Min                    | Typ  | Max                  | Min                           | Max                  |      |
| V <sub>IH</sub>  | HIGH Level Input Voltage  | 1.65 to 1.95        |                                                                                | 0.65 V <sub>CC</sub>   | –    | –                    | 0.65 V <sub>CC</sub>          | –                    | V    |
|                  |                           | 2.3 to 5.5          |                                                                                | 0.7 V <sub>CC</sub>    | –    | –                    | 0.7 V <sub>CC</sub>           | –                    |      |
| V <sub>IL</sub>  | LOW Level Input Voltage   | 1.65 to 1.95        |                                                                                | –                      | –    | 0.35 V <sub>CC</sub> | –                             | 0.35 V <sub>CC</sub> | V    |
|                  |                           | 2.3 to 5.5          |                                                                                | –                      | –    | 0.3 V <sub>CC</sub>  | –                             | 0.3 V <sub>CC</sub>  |      |
| I <sub>LKG</sub> | HIGH Level Output Leakage | 5.5                 | V <sub>IN</sub> = V <sub>IL</sub><br>V <sub>OUT</sub> = V <sub>CC</sub> or GND | –                      | –    | ±5                   | –                             | ±10                  | μA   |
| V <sub>OL</sub>  | LOW Level Output Voltage  | 1.65                | V <sub>IN</sub> = V <sub>IH</sub><br>I <sub>OL</sub> = 100 μA                  | –                      | 0.0  | 0.1                  | –                             | 0.1                  | V    |
|                  |                           | 2.3                 |                                                                                | –                      | 0.0  | 0.1                  | –                             | 0.1                  |      |
|                  |                           | 3.0                 |                                                                                | –                      | 0.0  | 0.1                  | –                             | 0.1                  |      |
|                  |                           | 4.5                 |                                                                                | –                      | 0.0  | 0.1                  | –                             | 0.1                  |      |
|                  |                           | 1.65                | I <sub>OL</sub> = 4 mA                                                         | –                      | 0.08 | 0.24                 | –                             | 0.24                 |      |
|                  |                           | 2.3                 |                                                                                | –                      | 0.10 | 0.3                  | –                             | 0.3                  |      |
|                  |                           | 3.0                 |                                                                                | –                      | 0.15 | 0.4                  | –                             | 0.4                  |      |
|                  |                           | 3.0                 |                                                                                | –                      | 0.22 | 0.55                 | –                             | 0.55                 |      |
|                  |                           | 4.5                 |                                                                                | –                      | 0.22 | 0.55                 | –                             | 0.55                 |      |
|                  |                           |                     | I <sub>OL</sub> = 8 mA                                                         | –                      | 0.10 | 0.3                  | –                             | 0.3                  |      |
|                  |                           |                     | I <sub>OL</sub> = 16 mA                                                        | –                      | 0.15 | 0.4                  | –                             | 0.4                  |      |
|                  |                           |                     | I <sub>OL</sub> = 24 mA                                                        | –                      | 0.22 | 0.55                 | –                             | 0.55                 |      |
|                  |                           |                     | I <sub>OL</sub> = 32 mA                                                        | –                      | 0.22 | 0.55                 | –                             | 0.55                 |      |
| I <sub>IN</sub>  | Input Leakage Current     | 5.5                 | V <sub>IN</sub> = 5.5 V, GND                                                   | –                      | –    | ±0.1                 | –                             | ±1                   | μA   |
| I <sub>OFF</sub> | Power Off Leakage Current | 0.0                 | V <sub>IN</sub> or V <sub>OUT</sub> = 5.5 V                                    | –                      | –    | 1                    | –                             | 10                   | μA   |
| I <sub>CC</sub>  | Quiescent Supply Current  | 1.65 to 5.5         | V <sub>IN</sub> = 5.5 V, GND                                                   | –                      | –    | 1                    | –                             | 10                   | μA   |

## AC ELECTRICAL CHARACTERISTICS

| Symbol           | Parameter                                   | V <sub>CC</sub> (V) | Conditions                                                                                                            | T <sub>A</sub> = +25°C |     |     | T <sub>A</sub> = -40 to +85°C |     | Unit |
|------------------|---------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------|------------------------|-----|-----|-------------------------------|-----|------|
|                  |                                             |                     |                                                                                                                       | Min                    | Typ | Max | Min                           | Max |      |
| t <sub>PZL</sub> | Propagation Delay<br>(Figure 5, 7)          | 1.8 ±0.15           | C <sub>L</sub> = 50 pF,<br>R <sub>U</sub> = 500 Ω,<br>R <sub>D</sub> = 500 Ω,<br>V <sub>I</sub> = 2 × V <sub>CC</sub> | –                      | 5.2 | 9.2 | –                             | 9.6 | ns   |
|                  |                                             | 2.5 ±0.2            |                                                                                                                       | –                      | 3.5 | 5.7 | –                             | 6.1 |      |
|                  |                                             | 3.3 ±0.3            |                                                                                                                       | –                      | 2.8 | 4.1 | –                             | 4.5 |      |
|                  |                                             | 5.0 ±0.5            |                                                                                                                       | –                      | 2.2 | 3.4 | –                             | 3.6 |      |
| t <sub>PLZ</sub> | Propagation Delay<br>(Figure 5, 7)          | 1.8 ±0.15           | C <sub>L</sub> = 50 pF,<br>R <sub>U</sub> = 500 Ω,<br>R <sub>D</sub> = 500 Ω,<br>V <sub>I</sub> = 2 × V <sub>CC</sub> | –                      | 4.6 | 9.2 | –                             | 9.6 | ns   |
|                  |                                             | 2.5 ±0.2            |                                                                                                                       | –                      | 3.2 | 5.7 | –                             | 6.1 |      |
|                  |                                             | 3.3 ±0.3            |                                                                                                                       | –                      | 2.4 | 4.1 | –                             | 4.5 |      |
|                  |                                             | 5.0 ±0.5            |                                                                                                                       | –                      | 1.6 | 3.4 | –                             | 3.6 |      |
| C <sub>IN</sub>  | Input Capacitance                           | 0                   |                                                                                                                       | –                      | 2.5 | –   | –                             | –   | pF   |
| C <sub>OUT</sub> | Output Capacitance                          | 0                   |                                                                                                                       | –                      | 4.2 | –   | –                             | –   | pF   |
| C <sub>PD</sub>  | Power Dissipation Capacitance<br>(Figure 6) | 3.3                 | (Note 2)                                                                                                              | –                      | 7   | –   | –                             | –   | pF   |
|                  |                                             | 5.0                 |                                                                                                                       | –                      | 9   | –   | –                             | –   |      |

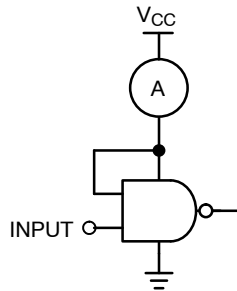
2. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I<sub>CCD</sub>) at no output loading and operating at 50% duty cycle. (see Figure 6) C<sub>PD</sub> is related to I<sub>CCD</sub> dynamic operating current by the expression:  
I<sub>CCD</sub> = (C<sub>PD</sub>) (V<sub>CC</sub>) (f<sub>IN</sub>) + (I<sub>CCstatic</sub>).

## AC Loading and Waveforms



$C_L$  includes load and stray capacitance  
Input PRR = 1.0 MHz,  $t_W = 500$  ns

Figure 5. AC Test Circuit



Input = AC Waveform;  $t_r = t_f = 1.8$  ns;  
PRR = 10 MHz; Duty Cycle = 50%.

Figure 6.  $I_{CCD}$  Test Circuit

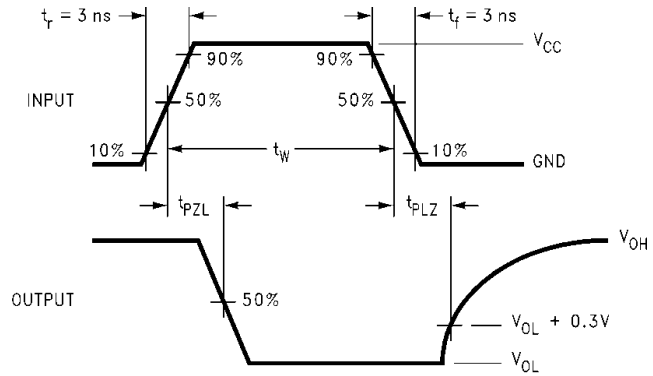


Figure 7. AC Waveforms

## ORDERING INFORMATION

| Order Number | Top Mark | Package                                               | Shipping†          |
|--------------|----------|-------------------------------------------------------|--------------------|
| NC7WZ38K8X   | WZ38     | 8-Lead US8, JEDEC MO-187, Variation CA<br>3.1 mm Wide | 3000 / Tape & Reel |
| NC7WZ38L8X   | U5       | 8-Lead MicroPak, 1.6 mm Wide<br>(Pb-Free)             | 5000 / Tape & Reel |

## DISCONTINUED (Note 4)

|                   |      |                                                       |                    |
|-------------------|------|-------------------------------------------------------|--------------------|
| NC7WZ38K8X-L22236 | WZ38 | 8-Lead US8, JEDEC MO-187, Variation CA<br>3.1 mm Wide | 3000 / Tape & Reel |
| NC7WZ38L8X-L22185 | U5   | 8-Lead MicroPak, 1.6 mm Wide<br>(Pb-Free)             | 5000 / Tape & Reel |

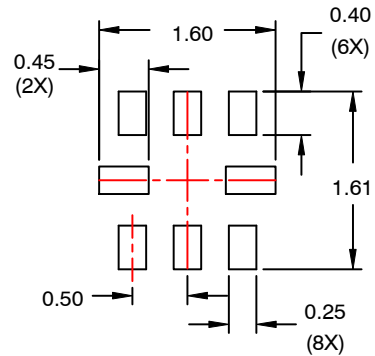
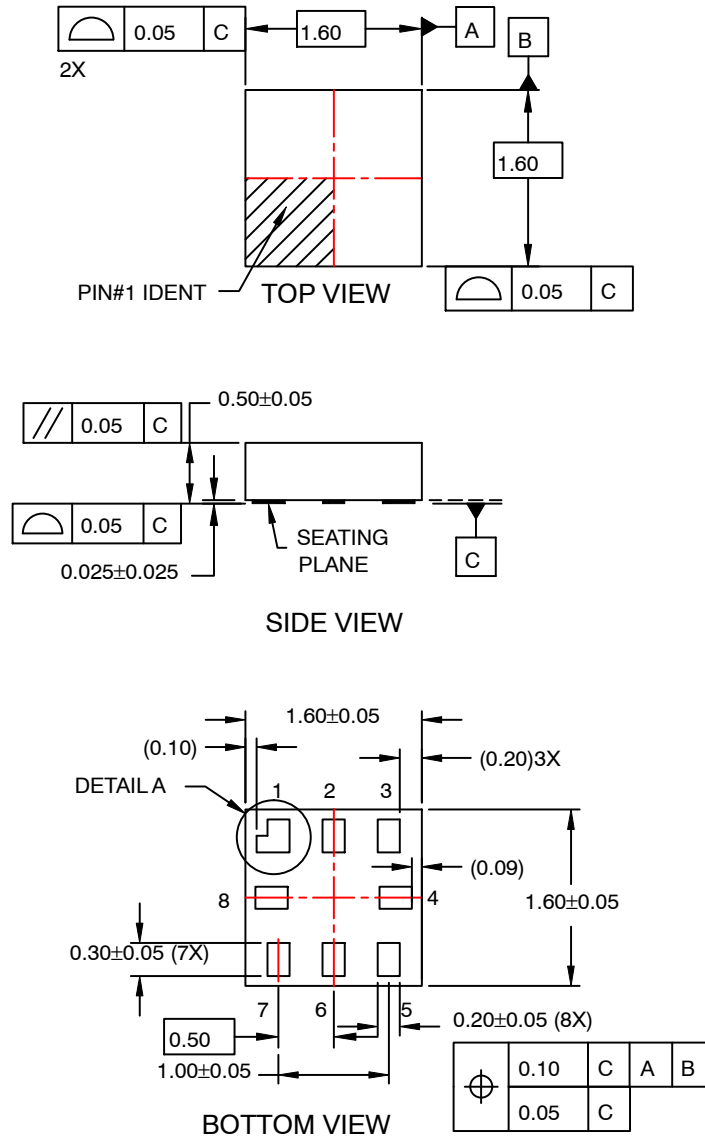
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

4. **DISCONTINUED:** These devices are not recommended for new design. Please contact your **onsemi** representative for information. The most current information on these devices may be available on [www.onsemi.com](http://www.onsemi.com).

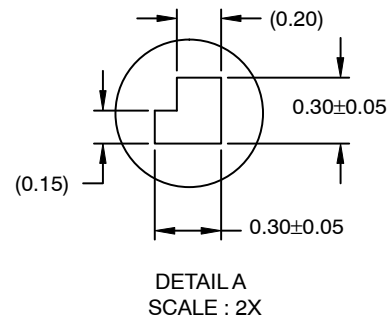
**UQFN8 1.6X1.6, 0.5P**  
CASE 523AY  
ISSUE O

DATE 31 AUG 2016



**NOTES:**

- A. PACKAGE CONFORMS TO JEDEC MO-255 VARIATION UAAD.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009.
- D. LAND PATTERN RECOMMENDATION IS EXISTING INDUSTRY LAND PATTERN.

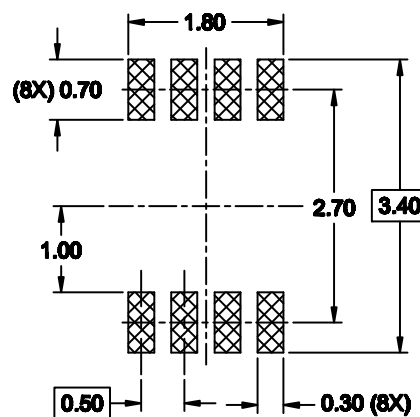
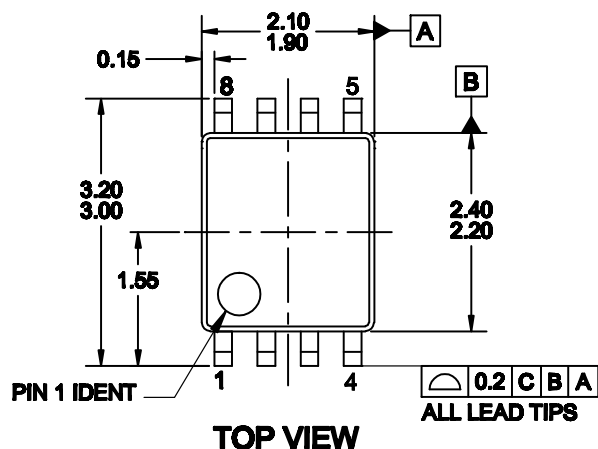


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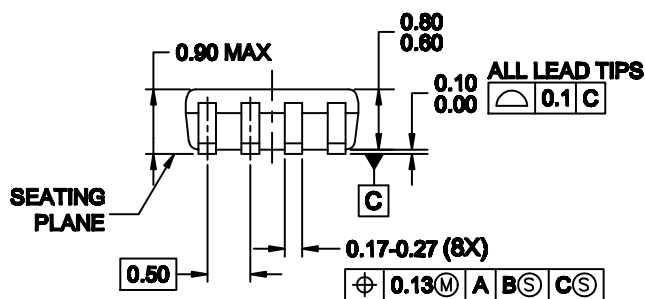
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**US8**  
CASE 846AN  
ISSUE O

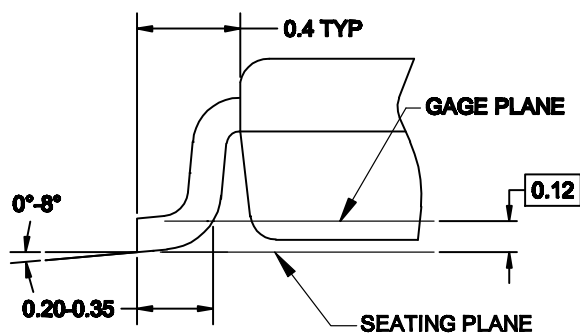
DATE 31 DEC 2016



## RECOMMENDED LAND PATTERN



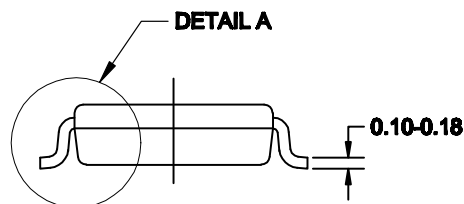
## SIDE VIEW



## DETAIL A

**NOTES:**

- 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, 1994.**



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