

# TinyLogic UHS Triple Inverter

## NC7NZ04

### Description

The NC7NZ04 is a triple inverter from ON Semiconductor's Ultra-High Speed (UHS) 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 broad  $V_{CC}$  operating range. The device is specified to operate over the 1.65 V to 5.5 V  $V_{CC}$  operating 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.

### Features

- Ultra-High Speed:  $t_{PD} = 2.4$  ns (Typical) into 50 pF at 5 V  $V_{CC}$
- High Output Drive:  $\pm 24$  mA at 3 V  $V_{CC}$
- Broad  $V_{CC}$  Operating Range: 1.65 V to 5.5 V Power-Down, High-Impedance Inputs / Outputs
- Over-Voltage Tolerance Inputs Facilitate 5 V to 3 V Translation
- Proprietary Noise / EMI Reduction Circuitry
- Space-Saving MicroPak™ and US8 Surface Mount Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

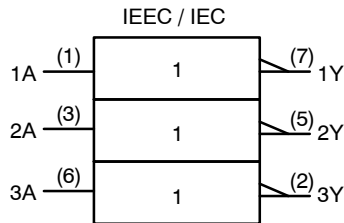


Figure 1. Logic Symbol

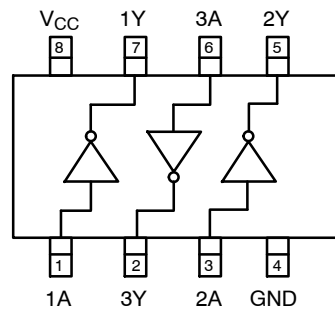


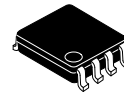
Figure 2. Connection Diagram



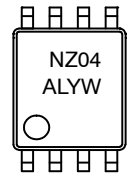
ON Semiconductor®

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### MARKING DIAGRAMS



US8  
CASE 846AN



UQFN8 1.6X1.6, 0.5P  
CASE 523AY



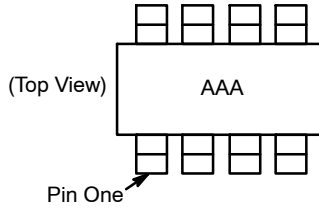
NZ04, T3 = Specific Device Code  
A = Assembly Site  
L = Wafer Lot Number  
YW = Assembly Start Week  
KK = 2-Digit Lot Run Traceability Code  
XY = 2-Digit Date Code  
Z = Assembly Plant Code

### ORDERING INFORMATION

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

# NC7NZ04

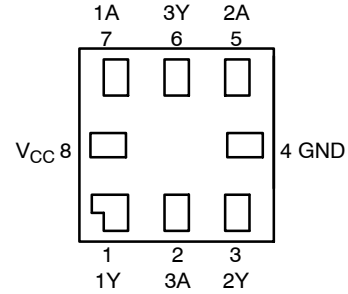
## Pin Configurations



**NOTES:**

1. AAA represents product code top mark (see ordering table).
2. Orientation of top mark determines pin one location. Reading the top product code mark left to right, pin one is the lower left pin.

**Figure 3. US8**



**Figure 4. MicroPak (Top Through View)**

## PIN DEFINITIONS

| Pin # US8 | Pin # MicroPak | Name            | Description    |
|-----------|----------------|-----------------|----------------|
| 1         | 7              | 1A              | Input          |
| 2         | 6              | 3Y              | Output         |
| 3         | 5              | 2A              | Input          |
| 4         | 4              | GND             | Ground         |
| 5         | 3              | 2Y              | Output         |
| 6         | 2              | 3A              | Input          |
| 7         | 1              | 1Y              | Output         |
| 8         | 8              | V <sub>CC</sub> | Supply Voltage |

## FUNCTION TABLE

| Inputs   | Output   |
|----------|----------|
| <b>A</b> | <b>Y</b> |
| L        | H        |
| H        | L        |

## 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  |      | -    |    |
| I <sub>OK</sub>                     | DC Output Diode Current                           | V <sub>OUT</sub> < 0 V |      | -    |    |
| I <sub>OUT</sub>                    | DC Output Current                                 | -                      | ±50  | mA   |    |
| I <sub>CC</sub> or I <sub>GND</sub> | DC V <sub>CC</sub> or Ground Current              | -                      | ±50  | mA   |    |
| T <sub>STG</sub>                    | Storage Temperature Range                         | -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                    | US8                    | -    | 500  | mW |
|                                     |   | MicroPak-8             | -    | 539  |    |
| ESD                                 | Human Body Model, JEDEC: JESD22-A114              | -                      | 4000 | V    |    |
|                                     | Charge Device Model, JEDEC: JESD22-C101           | -                      | 2000 |      |    |

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.

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## RECOMMENDED OPERATING CONDITIONS

| Symbol                          | Parameter                     | Conditions                             | 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 Times     | V <sub>CC</sub> at 1.8 V, 2.5 V ±0.2 V | 0    | 20              | ns/V |
|                                 |                               | V <sub>CC</sub> at 3.3 V ±0.3 V        | 0    | 10              |      |
|                                 |                               | V <sub>CC</sub> at 5.0 V ±0.5 V        | 0    | 5               |      |
| θ <sub>JA</sub>                 | Thermal Resistance            | US8                                    | -    | 250             | °C/W |
|                                 |                               | MicroPak-8                             | -    | 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.

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

## DC ELECTRICAL CHARACTERISTICS

| Symbol           | Parameter                 | V <sub>CC</sub> | 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    |      |
|                  |                           | 2.30 to 5.50    |   | 0.70 V <sub>CC</sub>     | -    | -                    | 0.70 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    |      |
|                  |                           | 2.30 to 5.50    |   | -                        | -    | 0.30 V <sub>CC</sub> | -                            | 0.30 V <sub>CC</sub> |      |      |
| V <sub>OH</sub>  | HIGH Level Output Voltage | 1.65            | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> ,<br>I <sub>OH</sub> = -100 μA | 1.55                     | 1.65 | -                    | 1.55                         | -                    | V    |      |
|                  |                           | 2.30            |   | 2.20                     | 2.30 | -                    | 2.20                         | -                    |      |      |
|                  |                           | 3.00            |   | 2.90                     | 3.00 | -                    | 2.90                         | -                    |      |      |
|                  |                           | 4.50            |   | 4.40                     | 4.50 | -                    | 4.40                         | -                    |      |      |
|                  |                           | 1.65            | I <sub>OH</sub> = -4 mA   | 1.29                     | 1.52 | -                    | 1.29                         | -                    |      |      |
|                  |                           | 2.30            |   | I <sub>OH</sub> = -8 mA  | 1.90 | 2.15                 | -                            | 1.90                 |      | -    |
|                  |                           | 3.00            |   | I <sub>OH</sub> = -16 mA | 2.40 | 2.80                 | -                            | 2.40                 |      | -    |
|                  |                           | 3.00            |   | I <sub>OH</sub> = -24 mA | 2.30 | 2.68                 | -                            | 2.30                 |      | -    |
|                  |                           | 4.50            |   | I <sub>OH</sub> = -32 mA | 3.80 | 4.20                 | -                            | 3.80                 |      | -    |
| V <sub>OL</sub>  | LOW Level Output Voltage  | 1.65            | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> ,<br>I <sub>OH</sub> = -100 μA | -                        | 0.00 | 0.10                 | -                            | 0.10                 | V    |      |
|                  |                           | 2.30            |   | -                        | 0.00 | 0.10                 | -                            | 0.10                 |      |      |
|                  |                           | 3.00            |   | -                        | 0.00 | 0.10                 | -                            | 0.10                 |      |      |
|                  |                           | 4.50            |   | -                        | 0.00 | 0.10                 | -                            | 0.10                 |      |      |
|                  |                           | 1.65            | I <sub>OH</sub> = 4 mA  | -                        | 0.80 | 0.24                 | -                            | 0.24                 |      |      |
|                  |                           | 2.30            |   | I <sub>OH</sub> = 8 mA   | -    | 0.10                 | 0.30                         | -                    |      | 0.30 |
|                  |                           | 3.00            |   | I <sub>OH</sub> = 16 mA  | -    | 0.15                 | 0.40                         | -                    |      | 0.40 |
|                  |                           | 3.00            |   | I <sub>OH</sub> = 24 mA  | -    | 0.22                 | 0.55                         | -                    |      | 0.55 |
|                  |                           | 4.50            |   | I <sub>OH</sub> = 32 mA  | -    | 0.22                 | 0.55                         | -                    |      | 0.55 |
| I <sub>IN</sub>  | Input Leakage Current     | 1.65 to 5.5     | V <sub>IN</sub> = 5.5 V, GND  | -                        | -    | ±1                   | -                            | ±1                   | μA   |      |
| I <sub>OFF</sub> | Power-Off Leakage Current | 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 5.50    | V <sub>IN</sub> = 5.5 V, GND  | -                        | -    | 1                    | -                            | 10                   | μA   |      |

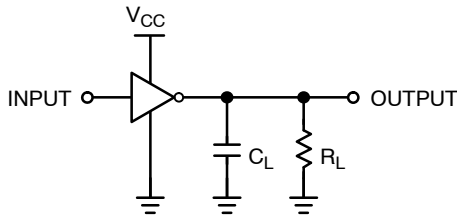
AC ELECTRICAL CHARACTERISTICS

| Symbol                              | Parameter  | V <sub>CC</sub> | Conditions                                       | T <sub>A</sub> = 25°C                             |     |     | T <sub>A</sub> = -40 to 85°C |      | Unit |
|-------------------------------------|--|-----------------|--|---|-----|-----|------------------------------|------|------|
|                                     |  |                 |  | Min   | Typ | Max | Min                          | Max  |      |
| t <sub>PLH</sub> , t <sub>PHL</sub> | Propagation Delay<br>(Figure 5, 6)                   | 1.80 ± 0.15     | C <sub>L</sub> = 15 pF,<br>R <sub>L</sub> = 1 MΩ | -   | 4.4 | 9.5 | -                            | 10.0 | ns   |
|                                     |  | 2.50 ± 0.20     |  | -   | 2.9 | 5.1 | -                            | 5.6  |      |
|                                     |  | 3.30 ± 0.30     |  | -   | 2.1 | 3.4 | -                            | 3.8  |      |
|                                     |  | 5.00 ± 0.50     |  | -   | 1.8 | 2.8 | -                            | 3.1  |      |
|                                     |  | 3.30 ± 0.30     |  | C <sub>L</sub> = 50 pF,<br>R <sub>L</sub> = 500 Ω | -   | 2.9 | 4.5                          | -    |      |
|                                     |  | 5.00 ± 0.50     | -  |   | 2.4 | 3.6 | -                            | 4.0  |      |
| C <sub>IN</sub>                     | Input Capacitance                                    | 0               |  | -   | 2.5 | -   | -                            | -    | pF   |
| C <sub>PD</sub>                     | Power Dissipation Capacitance<br>(Note 4) (Figure 7) | 3.30            |  | -   | 9   | -   | -                            | -    | pF   |
|                                     |  | 5.00            |  | -   | 11  | -   | -                            | -    |      |

4. 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. 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>CC</sub>static).

DYNAMIC SWITCHING CHARACTERISTICS

| Symbol           | Parameter                                   | Conditions   | V <sub>CC</sub> | T <sub>A</sub> = 25°C | Unit |
|------------------|---|--|-----------------|-----------------------|------|
|                  |   |  |                 | Typ                   |      |
| V <sub>OLP</sub> | Quiet Output Dynamic Peak V <sub>OL</sub>   | C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 5.0 V, V <sub>IL</sub> = 0 V | 5.0             | 0.8                   | V    |
| V <sub>OLV</sub> | Quiet Output Dynamic Valley V <sub>OL</sub> |  | 5.0             | -0.8                  | V    |



NOTE:  
5. C<sub>L</sub> includes load and stray capacitance;  
inputs PRR = 1.0 MHz, t<sub>w</sub> = 500 ns.

Figure 5. AC Test Circuit

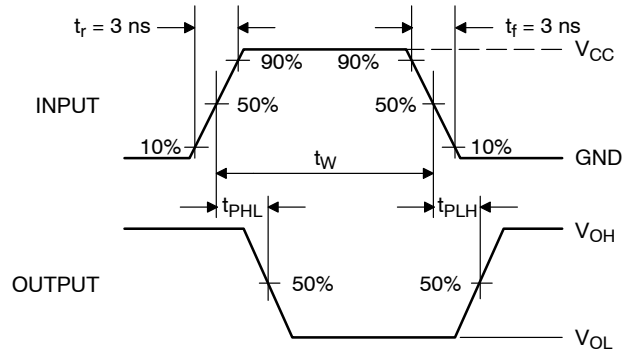
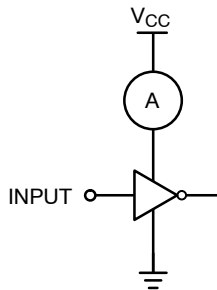


Figure 6. AC Waveforms



NOTE:  
6. Input = AC Waveform; t<sub>r</sub> = t<sub>f</sub> = 1.8 ns;  
PRR = 10 MHz; Duty Cycle = 50%.

Figure 7. I<sub>CCD</sub> Test Circuit

# NC7NZ04

## DEVICE ORDERING INFORMATION

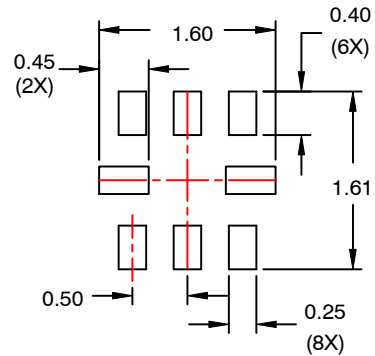
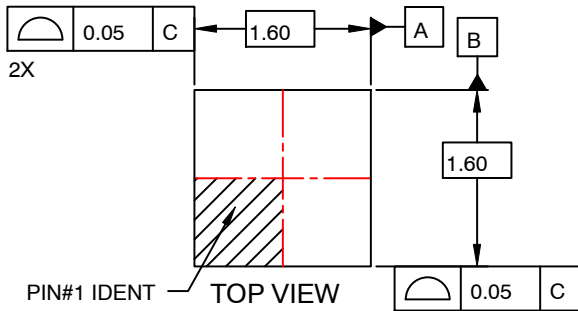
| Device     | Top Mark | Packages   | Shipping†          |
|------------|----------|--|--------------------|
| NC7NZ04K8X | NZ04     | 8-Lead US8, JEDEC MO-187, Variation CA 3.1 mm Wide | 3000 / Tape & Reel |
| NC7NZ04L8X | T3       | 8-Lead MicroPak, 1.6 mm Wide                       | 5000 / Tape & 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.

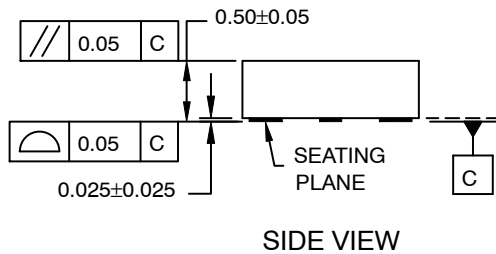
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**UQFN8 1.6X1.6, 0.5P**  
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ISSUE O

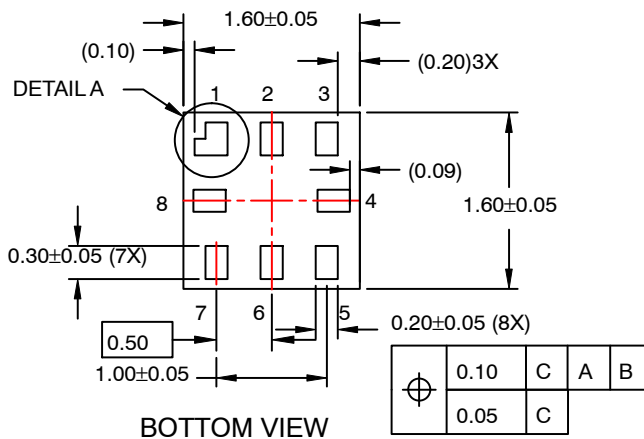
DATE 31 AUG 2016



**RECOMMENDED  
LAND PATTERN**



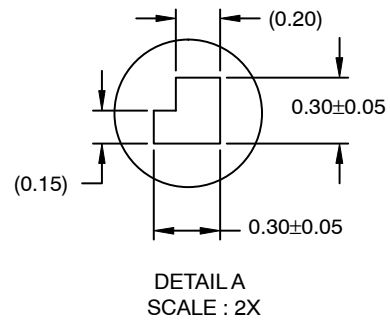
**SIDE VIEW**



**BOTTOM VIEW**

**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.



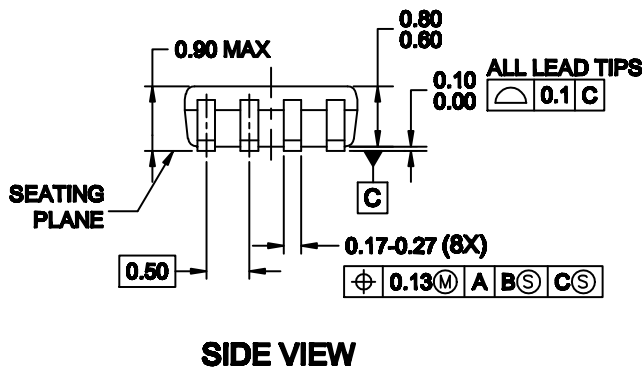
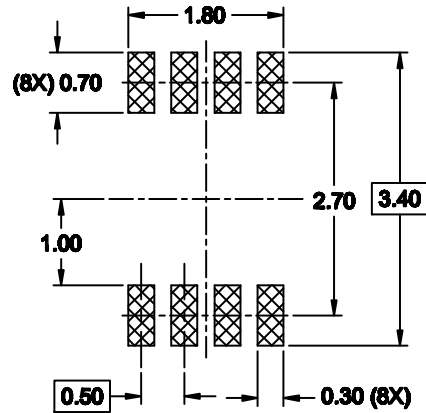
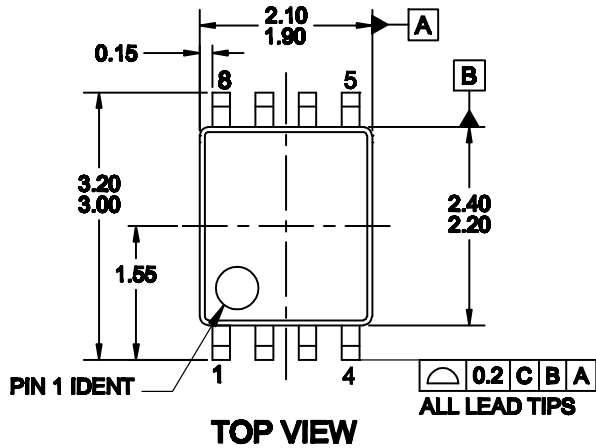
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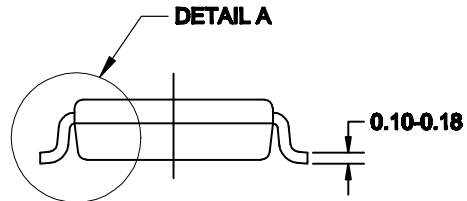
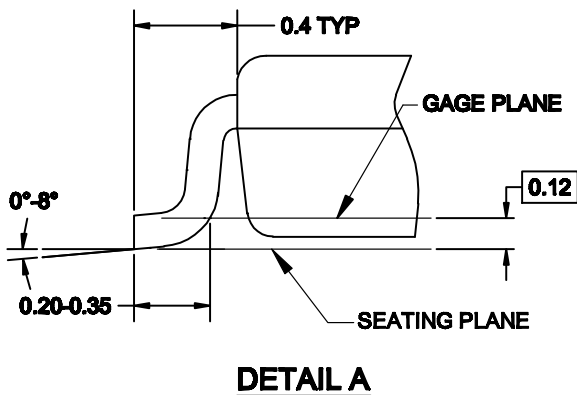
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- A. CONFORMS TO JEDEC REGISTRATION MO-187
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1994.



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