

# TinyLogic ULP-A Dual 2-Input NAND Gate



ON Semiconductor®

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## NC7WP00

The NC7WP00 is a dual 2-input NAND gate in tiny footprint packages. The device is designed to operate for  $V_{CC} = 0.9\text{ V}$  to  $3.6\text{ V}$ .

### Features

- Designed for 0.9 V to 3.6 V  $V_{CC}$  Operation
- 2.1 ns  $t_{PD}$  at 3.3 V (Typ)
- Inputs/Outputs Over-Voltage Tolerant up to 3.6 V
- $I_{OFF}$  Supports Partial Power Down Protection
- Source/Sink 2.6 mA at 3.3 V
- Available in US8 and MicroPak™ Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

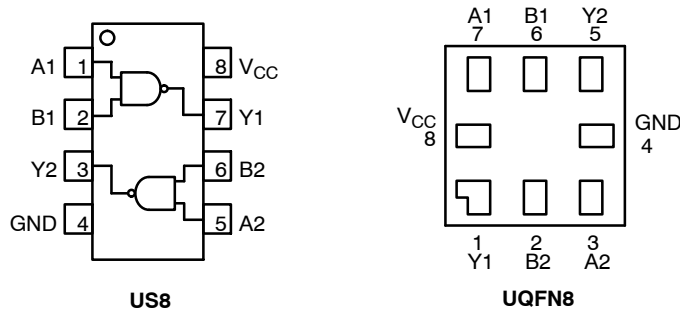


Figure 1. Pinout Diagrams (Top Views)

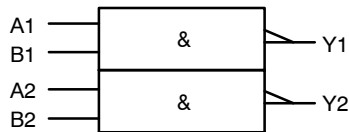


Figure 2. Logic Symbol

### PIN ASSIGNMENT

Pin	US8	UQFN8
1	A1	Y1
2	B1	B2
3	Y2	A2
4	GND	GND
5	A2	Y2
6	B2	B1
7	Y1	A1
8	$V_{CC}$	$V_{CC}$

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

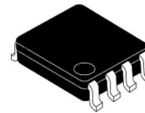
Inputs		Output
A	B	Y
L	L	H
L	H	H
H	L	H
H	H	L

NOTE: H = HIGH Logic Level  
L = LOW Logic Level

### MARKING DIAGRAMS



UQFN8  
1.6X1.6, 0.5P  
CASE 523AY



US8  
CASE 846AN



CC, XXXX = 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 on page 6 of this data sheet.

# NC7WP00

## MAXIMUM RATINGS

Symbol	Characteristics	Value	Unit
V <sub>CC</sub>	DC Supply Voltage	-0.5 to +4.3	V
V <sub>IN</sub>	DC Input Voltage	-0.5 to +4.3	V
V <sub>OUT</sub>	DC Output Voltage Active-Mode (High or Low State) Tri-State Mode (Note 1) Power-Down Mode (V <sub>CC</sub> = 0 V)	-0.5 to V <sub>CC</sub> + 0.5 -0.5 to +4.3 -0.5 to +4.3	V
I <sub>IK</sub>	DC Input Diode Current V <sub>IN</sub> < GND	-50	mA
I <sub>OK</sub>	DC Output Diode Current V <sub>OUT</sub> < GND	-50	mA
I <sub>OUT</sub>	DC Output Source/Sink Current	±50	mA
I <sub>CC</sub> or I <sub>GND</sub>	DC Supply Current per Supply Pin or Ground Pin	±50	mA
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C
T <sub>J</sub>	Junction Temperature Under Bias	+150	°C
θ <sub>JA</sub>	Thermal Resistance (Note 2) US8 MicroPak	250 210	°C/W
P <sub>D</sub>	Power Dissipation in Still Air US8 MicroPak	500 595	mW
MSL	Moisture Sensitivity	Level 1	-
F <sub>R</sub>	Flammability Rating Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in	-
V <sub>ESD</sub>	ESD Withstand Voltage (Note 3) Human Body Model Charged Device Model	2000 1000	V
I <sub>Latchup</sub>	Latchup Performance (Note 4)	±100	mA

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.

1. Applicable to devices with outputs that may be tri-stated.
2. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2 ounce copper trace no air flow per JESD51-7.
3. HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.
4. Tested to EIA/JESD78 Class II.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	Positive DC Supply Voltage	0.9	3.6	V
V <sub>IN</sub>	DC Input Voltage	0	3.6	V
V <sub>OUT</sub>	DC Output Voltage Active-Mode (High or Low State) Tri-State Mode (Note 1) Power-Down Mode (V <sub>CC</sub> = 0 V)	0 0 0	V <sub>CC</sub> 3.6 3.6	V
T <sub>A</sub>	Operating Temperature Range	-40	+85	°C
t <sub>r</sub> , t <sub>f</sub>	Input Transition Rise and Fall Time V <sub>CC</sub> = 3.3 V ± 0.3 V	0	10	ns/V

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.

# NC7WP00

## DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Unit
				Min	Typ	Max	Min	Max	
V <sub>IH</sub>	High-Level Input Voltage		0.9	-	0.5	-	-	-	V
			1.1 to 1.3	0.65 x V <sub>CC</sub>	-	-	0.65 x V <sub>CC</sub>	-	
			1.4 to 1.6	0.65 x V <sub>CC</sub>	-	-	0.65 x V <sub>CC</sub>	-	
			1.65 to 1.95	0.65 x V <sub>CC</sub>	-	-	0.65 x V <sub>CC</sub>	-	
			2.3 to 2.7	1.6	-	-	1.6	-	
3.0 to 3.6	2.1	-	-	2.1	-				
V <sub>IL</sub>	Low-Level Input Voltage		0.9	-	0.5	-	-	-	V
			1.1 to 1.3	-	-	0.35 x V <sub>CC</sub>	-	0.35 x V <sub>CC</sub>	
			1.4 to 1.6	-	-	0.35 x V <sub>CC</sub>	-	0.35 x V <sub>CC</sub>	
			1.65 to 1.95	-	-	0.35 x V <sub>CC</sub>	-	0.35 x V <sub>CC</sub>	
			2.3 to 2.7	-	-	0.7	-	0.7	
3.0 to 3.6	-	-	0.9	-	0.9				
V <sub>OH</sub>	High-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>							V
		I <sub>OH</sub> = -20 μA	0.9	-	V <sub>CC</sub> - 0.1	-	-	-	
			1.1 to 1.3	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	
			1.4 to 1.6	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	
			1.65 to 1.95	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	
			2.3 to 2.7	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	
			3.0 to 3.6	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	
		I <sub>OH</sub> = -0.5 mA	1.1 to 1.3	0.75 x V <sub>CC</sub>	-	-	0.70 x V <sub>CC</sub>	-	
		I <sub>OH</sub> = -1 mA	1.4 to 1.6	1.07	-	-	0.99	-	
		I <sub>OH</sub> = -1.5 mA	1.65 to 1.95	1.24	-	-	1.22	-	
I <sub>OH</sub> = -2.1 mA	2.3 to 2.7	1.95	-	-	1.87	-			
I <sub>OH</sub> = -2.6 mA	3.0 to 3.6	2.61	-	-	2.55	-			
V <sub>OL</sub>	Low-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>							V
		I <sub>OL</sub> = 20 μA	0.9	-	0.1	-	-	-	
			1.1 to 1.3	-	-	0.1	-	0.1	
			1.4 to 1.6	-	-	0.1	-	0.1	
			1.65 to 1.95	-	-	0.1	-	0.1	
			2.3 to 2.7	-	-	0.1	-	0.1	
			3.0 to 3.6	-	-	0.1	-	0.1	
		I <sub>OL</sub> = 0.5 mA	1.1 to 1.3	-	-	0.3 x V <sub>CC</sub>	-	0.3 x V <sub>CC</sub>	
		I <sub>OL</sub> = 1 mA	1.4 to 1.6	-	-	0.31	-	0.37	
		I <sub>OL</sub> = 1.5 mA	1.65 to 1.95	-	-	0.31	-	0.35	
I <sub>OL</sub> = 2.1 mA	2.3 to 2.7	-	-	0.31	-	0.33			
I <sub>OL</sub> = 2.6 mA	3.0 to 3.6	-	-	0.31	-	0.33			
I <sub>IN</sub>	Input Leakage Current	V <sub>IN</sub> = 0 V to 3.6 V	0.9 to 3.6	-	-	±0.1	-	±0.5	μA
I <sub>OFF</sub>	Power Off Leakage Current	V <sub>IN</sub> = 0 V to 3.6 V or V <sub>OUT</sub> = 0 V to 3.6 V	0	-	-	0.5	-	0.5	μA
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	0.9 to 3.6	-	-	0.9	-	0.9	μA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

# NC7WP00

## AC ELECTRICAL CHARACTERISTICS

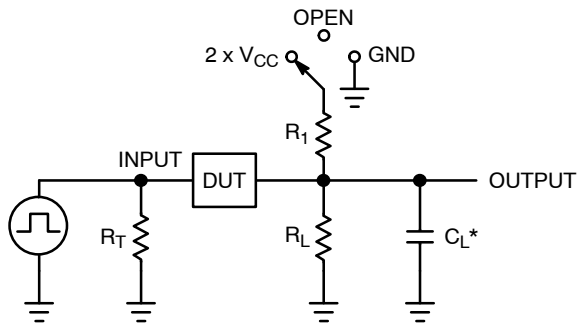
Symbol	Parameter	Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Unit
				Min	Typ	Max	Min	Max	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, (A or B) to Y (Figures 3 and 4)	R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 10 pF	0.9	-	40.7	-	-	-	ns
			1.10 to 1.30	-	10.9	23.5	-	31.0	
			1.40 to 1.60	-	5.6	12.0	-	14.0	
			1.65 to 1.95	-	3.7	10.0	-	12.0	
			2.3 to 2.7	-	2.7	7.0	-	8.0	
			3.0 to 3.6	-	2.1	6.0	-	7.0	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, (A or B) to Y (Figures 3 and 4)	R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF	0.9	-	42.2	-	-	-	ns
			1.10 to 1.30	-	11.4	24.9	-	34.0	
			1.40 to 1.60	-	6.0	13.0	-	16.0	
			1.65 to 1.95	-	4.0	10.0	-	12.0	
			2.3 to 2.7	-	3.0	7.0	-	8.0	
			3.0 to 3.6	-	2.3	6.0	-	7.0	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, (A or B) to Y (Figures 3 and 4)	R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 30 pF	0.9	-	46.4	-	-	-	ns
			1.10 to 1.30	-	13.0	28.9	-	43.0	
			1.40 to 1.60	-	7.3	16.0	-	18.0	
			1.65 to 1.95	-	5.1	12.0	-	14.0	
			2.3 to 2.7	-	3.7	9.0	-	10.0	
			3.0 to 3.6	-	2.9	7.0	-	9.0	

## CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition	Typical (T <sub>A</sub> = 25°C)	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>CC</sub> = 0 V	2.0	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>CC</sub> = 0 V	4.0	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Note 5)	f = 10 MHz, V <sub>CC</sub> = 0.9 to 3.6 V, V <sub>IN</sub> = 0 V or V <sub>CC</sub>	6.0	pF

5. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation I<sub>CC(OPR)</sub> = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>in</sub> + I<sub>CC</sub>. C<sub>PD</sub> is used to determine the no-load dynamic power consumption: P<sub>D</sub> = C<sub>PD</sub> • V<sub>CC</sub><sup>2</sup> • f<sub>in</sub> + I<sub>CC</sub> • V<sub>CC</sub>.

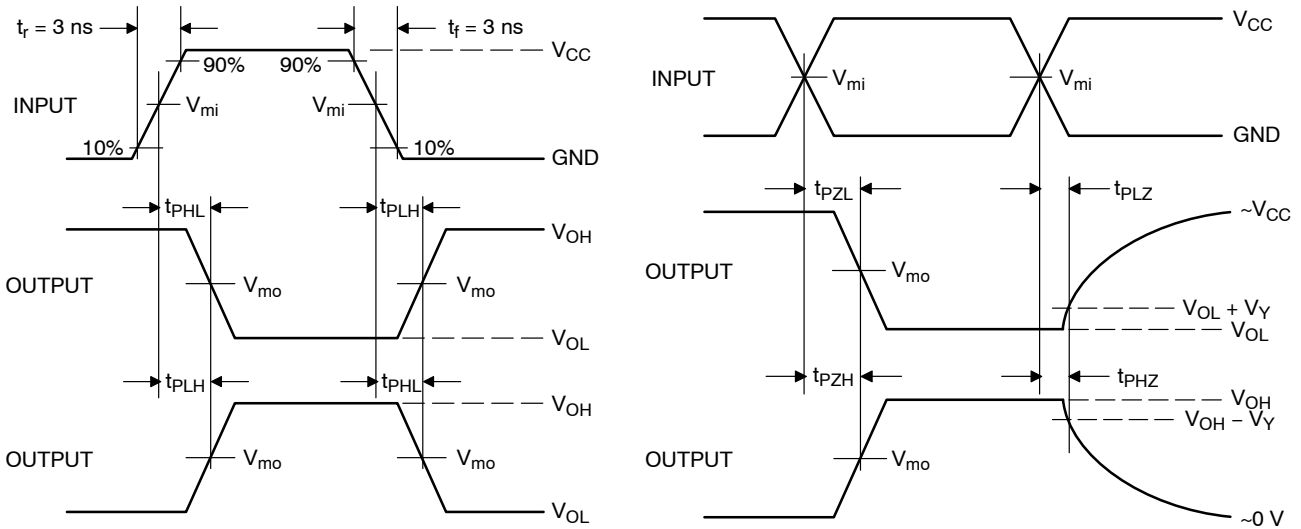
# NC7WP00



$C_L$  includes probe and jig capacitance  
 $R_T$  is  $Z_{OUT}$  of pulse generator (typically 50  $\Omega$ )  
 $f = 1$  MHz

Test	Switch Position
$t_{PLH} / t_{PHL}$	Open
$t_{PLZ} / t_{PZL}$	$2 \times V_{CC}$
$t_{PHZ} / t_{PZH}$	GND

Figure 3. Test Circuit



$V_{CC}, V$	$V_{mi}, V$	$V_{mo}, V$	$V_Y, V$
0.9	$V_{CC} / 2$	$V_{CC} / 2$	0.1
1.1 to 1.3	$V_{CC} / 2$	$V_{CC} / 2$	0.1
1.4 to 1.6	$V_{CC} / 2$	$V_{CC} / 2$	0.1
1.65 to 1.95	$V_{CC} / 2$	$V_{CC} / 2$	0.15
2.3 to 2.7	$V_{CC} / 2$	$V_{CC} / 2$	0.15
3.0 to 3.6	1.5	1.5	0.3

Figure 4. Switching Waveforms

# NC7WP00

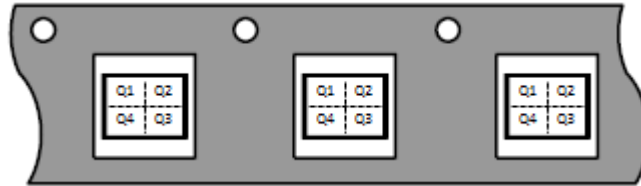
## ORDERING INFORMATION

Device	Package	Marking	Pin 1 Orientation (See below)	Shipping <sup>†</sup>
NC7WP00K8X	US8	WP00	Q4	3000 / Tape & Reel
NC7WP00L8X	MicroPak, UQFN8	Y3	Q4	5000 / Tape & Reel

<sup>†</sup>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.

### Pin 1 Orientation in Tape and Reel

Direction of Feed

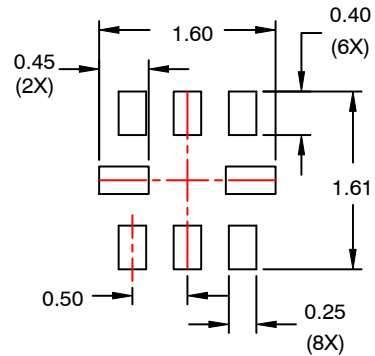
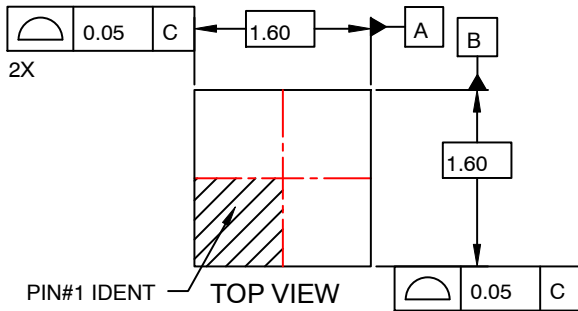


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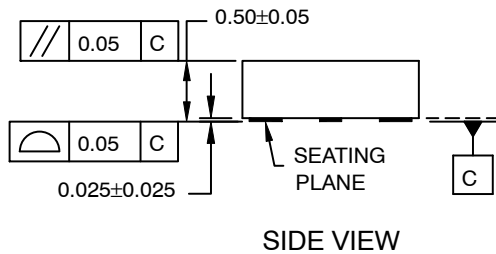


**UQFN8 1.6X1.6, 0.5P**  
CASE 523AY  
ISSUE O

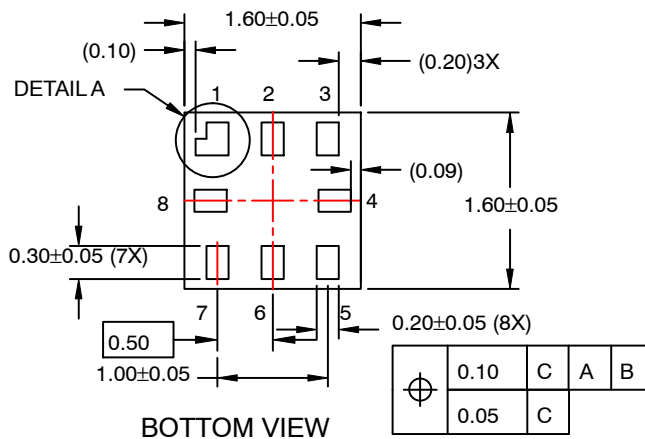
DATE 31 AUG 2016



**RECOMMENDED  
LAND PATTERN**



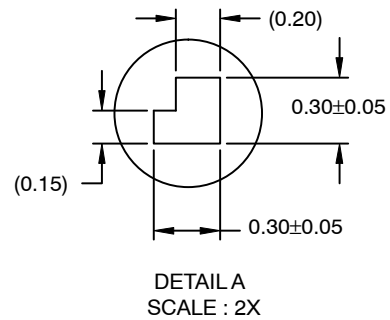
**SIDE VIEW**



**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.



**DETAIL A  
SCALE : 2X**

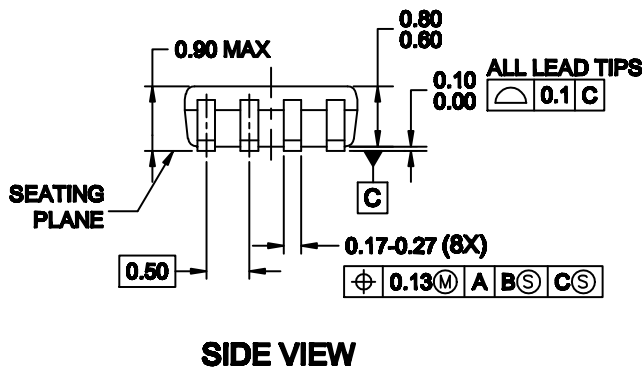
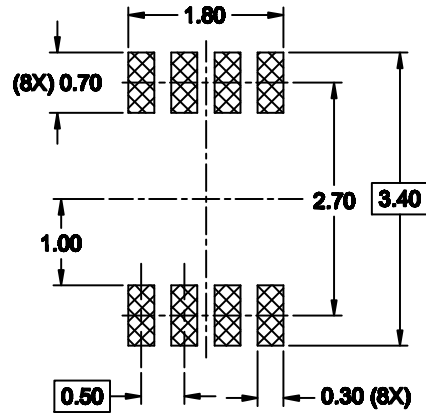
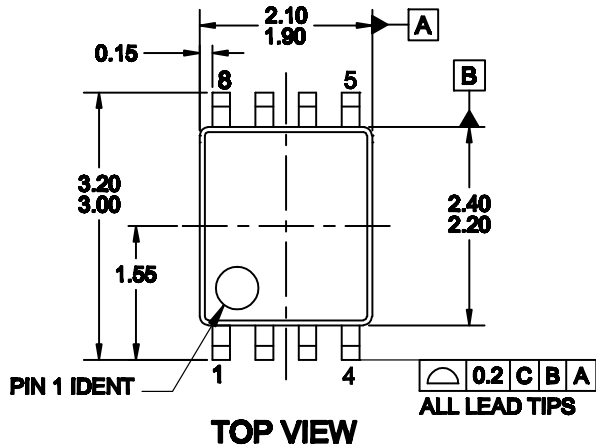
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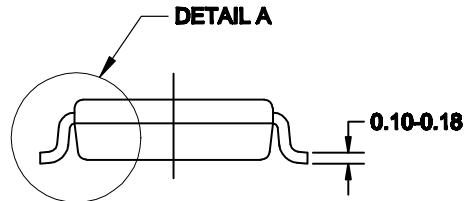
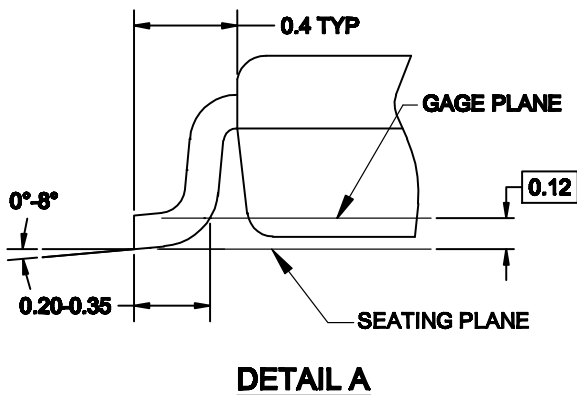
US8  
CASE 846AN  
ISSUE O

DATE 31 DEC 2016



**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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