

# NLU2G04

## Dual Inverter

The NLU2G04 MiniGate™ is an advanced high-speed CMOS dual inverter in ultra-small footprint.

The NLU2G04 input and output structures provide protection when voltages up to 7.0 V are applied, regardless of the supply voltage.

### Features

- High Speed:  $t_{PD} = 3.5 \text{ ns}$  (Typ) @  $V_{CC} = 5.0 \text{ V}$
- Low Power Dissipation:  $I_{CC} = 1 \mu\text{A}$  (Max) at  $T_A = 25^\circ\text{C}$
- Power Down Protection Provided on inputs
- Balanced Propagation Delays
- Overvoltage Tolerant (OVT) Input and Output Pins
- Ultra-Small Packages
- These are Pb-Free Devices

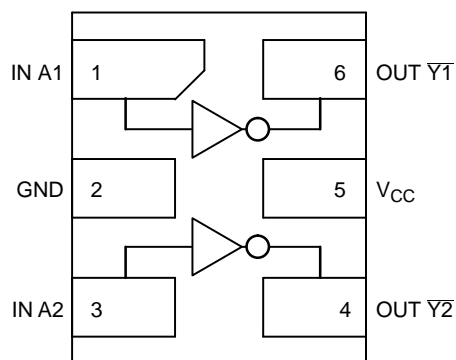


Figure 1. Pinout (Top View)

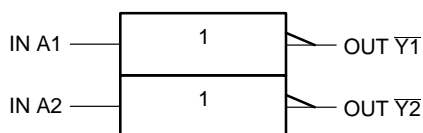


Figure 2. Logic Symbol

### PIN ASSIGNMENT

|   |          |
|---|----------|
| 1 | IN A1    |
| 2 | GND      |
| 3 | IN A2    |
| 4 | OUT Y2   |
| 5 | $V_{CC}$ |
| 6 | OUT Y1   |

### FUNCTION TABLE

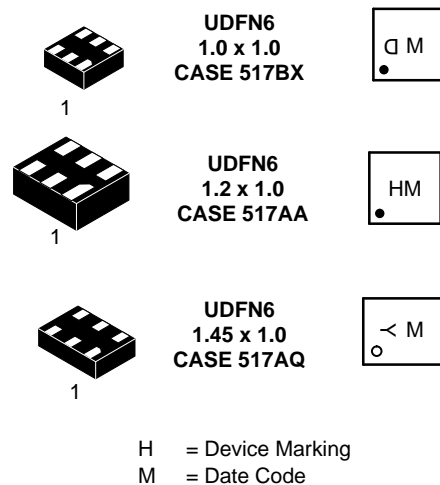
| A | $\bar{Y}$ |
|---|-----------|
| L | H         |
| H | L         |



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### MARKING DIAGRAMS



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

# NLU2G04

## MAXIMUM RATINGS

| Symbol        | Parameter  | Value                | Unit        |
|---------------|--|----------------------|-------------|
| $V_{CC}$      | DC Supply Voltage  | -0.5 to +7.0         | V           |
| $V_{IN}$      | DC Input Voltage   | -0.5 to +7.0         | V           |
| $V_{OUT}$     | DC Output Voltage  | -0.5 to +7.0         | V           |
| $I_{IK}$      | DC Input Diode Current<br>$V_{IN} < GND$                                     | -20                  | mA          |
| $I_{OK}$      | DC Output Diode Current<br>$V_{OUT} < GND$                                   | $\pm 20$             | mA          |
| $I_O$         | DC Output Source/Sink Current  | $\pm 12.5$           | mA          |
| $I_{CC}$      | DC Supply Current Per Supply Pin   | $\pm 25$             | mA          |
| $I_{GND}$     | DC Ground Current per Ground Pin   | $\pm 25$             | mA          |
| $T_{STG}$     | Storage Temperature Range  | -65 to +150          | $^{\circ}C$ |
| $T_L$         | Lead Temperature, 1 mm from Case for 10 Seconds                              | 260                  | $^{\circ}C$ |
| $T_J$         | Junction Temperature Under Bias  | 150                  | $^{\circ}C$ |
| MSL           | Moisture Sensitivity   | Level 1              |             |
| $F_R$         | Flammability Rating Oxygen<br>Index: 28 to 34                                | UL 94 V-0 @ 0.125 in |             |
| $I_{LATCHUP}$ | Latchup Performance Above $V_{CC}$ and Below GND at 125 $^{\circ}C$ (Note 2) | $\pm 500$            | 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. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2 ounce copper trace no air flow.
2. Tested to EIA / JESD78.

## RECOMMENDED OPERATING CONDITIONS

| Symbol              | Parameter  | Min    | Max       | Unit        |
|---------------------|--|--------|-----------|-------------|
| $V_{CC}$            | Positive DC Supply Voltage   | 1.65   | 5.5       | V           |
| $V_{IN}$            | Digital Input Voltage  | 0      | 5.5       | V           |
| $V_{OUT}$           | Output Voltage   | 0      | 5.5       | V           |
| $T_A$               | Operating Free-Air Temperature   | -55    | +125      | $^{\circ}C$ |
| $\Delta t/\Delta V$ | Input Transition Rise or Fall Rate<br>$V_{CC} = 3.3 V \pm 0.3 V$<br>$V_{CC} = 5.0 V \pm 0.5 V$ | 0<br>0 | 100<br>20 | ns/V        |

# NLU2G04

## DC ELECTRICAL CHARACTERISTICS

| Symbol          | Parameter                 | Conditions   | V <sub>CC</sub> (V) | T <sub>A</sub> = 25 °C |                   |                        | T <sub>A</sub> = +85°C |                        | T <sub>A</sub> = -55°C to +125°C |                        | Unit |
|-----------------|---------------------------|--|---------------------|------------------------|-------------------|------------------------|------------------------|------------------------|----------------------------------|------------------------|------|
|                 |                           |  |                     | Min                    | Typ               | Max                    | Min                    | Max                    | Min                              | Max                    |      |
| V <sub>IH</sub> | Low-Level Input Voltage   |  | 1.65                | 0.75 x V <sub>CC</sub> |                   |                        | 0.75 x V <sub>CC</sub> |                        |                                  |                        | V    |
|                 |                           |  | 2.3 to 5.5          | 0.70 x V <sub>CC</sub> |                   |                        | 0.70 x V <sub>CC</sub> |                        |                                  |                        |      |
| V <sub>IL</sub> | Low-Level Input Voltage   |  | 1.65                |                        |                   | 0.25 x V <sub>CC</sub> |                        | 0.25 x V <sub>CC</sub> |                                  | 0.25 x V <sub>CC</sub> | V    |
|                 |                           |  | 2.3 to 5.5          |                        |                   | 0.30 x V <sub>CC</sub> |                        | 0.30 x V <sub>CC</sub> |                                  | 0.30 x V <sub>CC</sub> |      |
| V <sub>OH</sub> | High-Level Output Voltage | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OH</sub> = -50 μA                           | 2.0<br>3.0<br>4.5   | 1.9<br>2.9<br>4.4      | 2.0<br>3.0<br>4.5 |                        | 1.9<br>2.9<br>4.4      |                        | 1.9<br>2.9<br>4.4                |                        | V    |
|                 |                           | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OH</sub> = -4 mA<br>I <sub>OH</sub> = -8 mA | 3.0<br>4.5          | 2.58<br>3.94           |                   |                        | 2.48<br>3.80           |                        | 2.34<br>3.66                     |                        | V    |
| V <sub>OL</sub> | Low-Level Output Voltage  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OL</sub> = 50 μA                            | 2.0<br>3.0<br>4.5   |                        | 0<br>0<br>0       | 0.1<br>0.1<br>0.1      |                        | 0.1<br>0.1<br>0.1      |                                  | 0.1<br>0.1<br>0.1      | V    |
|                 |                           | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OL</sub> = 4 mA<br>I <sub>OL</sub> = 8 mA   | 3.0<br>4.5          |                        |                   | 0.36<br>0.36           |                        | 0.44<br>0.44           |                                  | 0.52<br>0.52           |      |
| I <sub>IN</sub> | Input Leakage Current     | 0 ≤ V <sub>IN</sub> ≤ 5.5 V  | 0 to 5.5            |                        |                   | ±0.1                   |                        | ±1.0                   |                                  | ±1.0                   | μA   |
| I <sub>CC</sub> | Quiescent Supply Current  | 0 ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>  | 5.5                 |                        |                   | 1.0                    |                        | 10                     |                                  | 40                     | μA   |

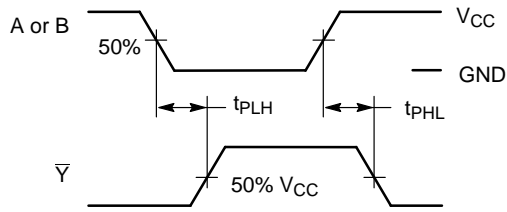
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## AC ELECTRICAL CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0 nS)

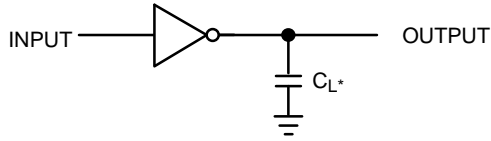
| Symbol                                 | Parameter   | V <sub>CC</sub> (V) | Test Condition         | T <sub>A</sub> = 25 °C |     |      | T <sub>A</sub> = +85°C |      | T <sub>A</sub> = -55°C to +125°C |      | Unit |
|--|---|---------------------|------------------------|------------------------|-----|------|------------------------|------|----------------------------------|------|------|
|  |   |                     |                        | Min                    | Typ | Max  | Min                    | Max  | Min                              | Max  |      |
| t <sub>pLH</sub> ,<br>t <sub>pHL</sub> | Propagation Delay,<br>Input A to Output $\bar{Y}$ | 3.0 to 3.6          | C <sub>L</sub> = 15 pF |                        | 4.5 | 7.1  |                        | 8.5  |                                  | 10.0 | ns   |
|  |   |                     | C <sub>L</sub> = 50 pF |                        | 6.4 | 10.6 |                        | 12.0 |                                  | 14.5 |      |
|  |   | 4.5 to 5.5          | C <sub>L</sub> = 15 pF |                        | 3.5 | 5.5  |                        | 6.5  |                                  | 8.0  |      |
|  |   |                     | C <sub>L</sub> = 50 pF |                        | 4.5 | 7.5  |                        | 8.5  |                                  | 10.0 |      |
| C <sub>IN</sub>                        | Input Capacitance                                 |                     |                        |                        | 4   | 10   |                        | 10   |                                  | 10.0 | pF   |
| C <sub>PD</sub>                        | Power Dissipation Capacitance (Note 3)            | 5.0                 |                        |                        | 8.0 |      |                        |      |                                  |      | pF   |

3. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the dynamic 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>.

# NLU2G04



**Figure 3. Switching Waveforms**



\*Includes all probe and jig capacitance.  
A 1-MHz square input wave is recommended for propagation delay tests.

**Figure 4. Test Circuit**

## ORDERING INFORMATION

| Device        | Package                              | Shipping†          |
|---------------|--------------------------------------|--------------------|
| NLU2G04MUTCG  | UDFN6, 1.2 x 1.0, 0.4P<br>(Pb-Free)  | 3000 / Tape & Reel |
| NLU2G04AMUTCG | UDFN6, 1.45 x 1.0, 0.5P<br>(Pb-Free) | 3000 / Tape & Reel |
| NLU2G04CMUTCG | UDFN6, 1.0 x 1.0, 0.35P<br>(Pb-Free) | 3000 / 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.

# MECHANICAL CASE OUTLINE

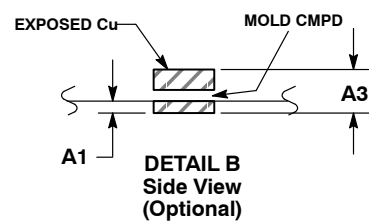
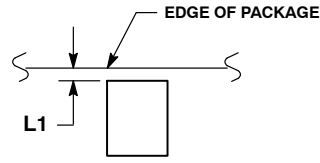
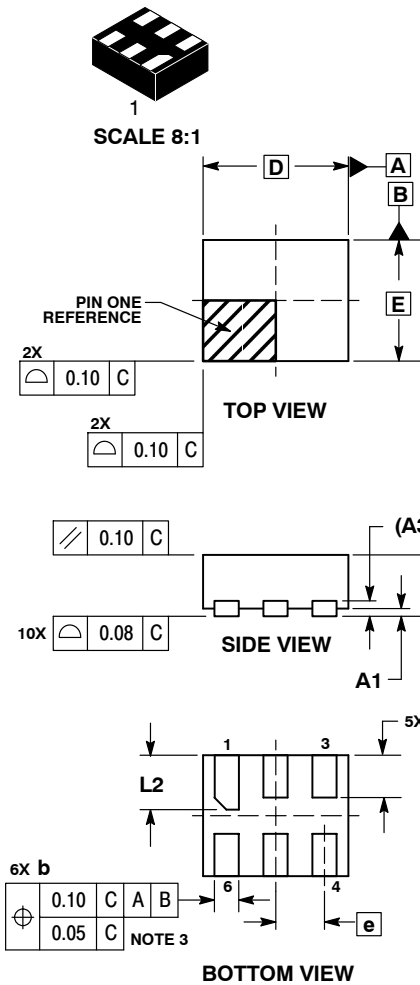
## PACKAGE DIMENSIONS

ON Semiconductor®



### UDFN6, 1.2x1.0, 0.4P CASE 517AA-01 ISSUE D

DATE 03 SEP 2010



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 mm FROM TERMINAL.
  4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| MILLIMETERS |       |      |
|-------------|-------|------|
| DIM         | MIN   | MAX  |
| A           | 0.45  | 0.55 |
| A1          | 0.00  | 0.05 |
| A3          | 0.127 | REF  |
| b           | 0.15  | 0.25 |
| D           | 1.20  | BSC  |
| E           | 1.00  | BSC  |
| e           | 0.40  | BSC  |
| L           | 0.30  | 0.40 |
| L1          | 0.00  | 0.15 |
| L2          | 0.40  | 0.50 |

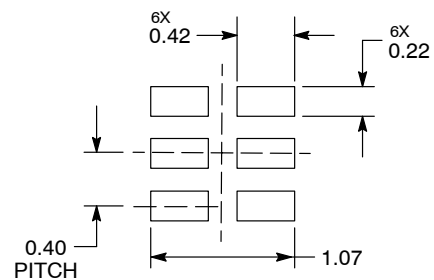
#### GENERIC MARKING DIAGRAM\*



X = Specific Device Code  
M = Date Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

#### MOUNTING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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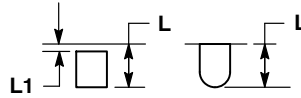
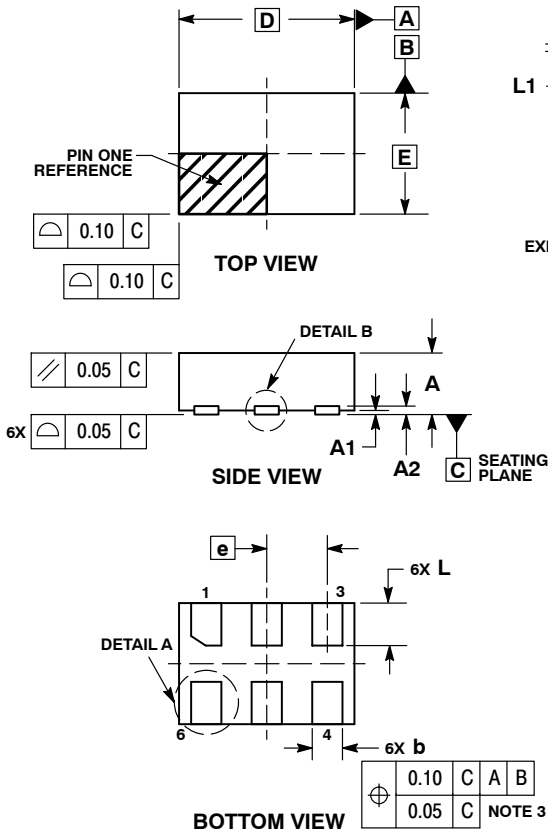
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



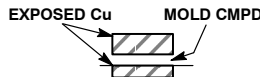
SCALE 4:1

UDFN6, 1.45x1.0, 0.5P  
CASE 517AQ  
ISSUE O

DATE 15 MAY 2008



**DETAIL A**  
OPTIONAL  
CONSTRUCTIONS



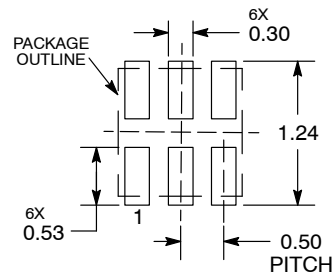
**DETAIL B**  
OPTIONAL  
CONSTRUCTIONS

**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 mm FROM THE TERMINAL TIP.

| MILLIMETERS |          |      |
|-------------|----------|------|
| DIM         | MIN      | MAX  |
| A           | 0.45     | 0.55 |
| A1          | 0.00     | 0.05 |
| A2          | 0.07 REF |      |
| b           | 0.20     | 0.30 |
| D           | 1.45 BSC |      |
| E           | 1.00 BSC |      |
| e           | 0.50 BSC |      |
| L           | 0.30     | 0.40 |
| L1          | ---      | 0.15 |

**MOUNTING FOOTPRINT**



DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**GENERIC  
MARKING DIAGRAM\***



X = Specific Device Code  
M = Date Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

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| <b>DESCRIPTION:</b>     | <b>UDFN6, 1.45x1.0, 0.5P</b> | <b>PAGE 1 OF 1</b>   |

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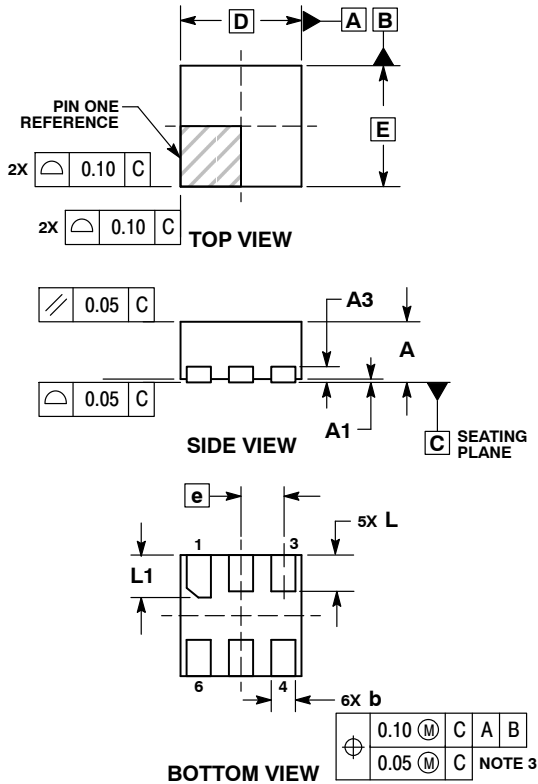
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



UDFN6, 1x1, 0.35P  
CASE 517BX  
ISSUE O

SCALE 4:1

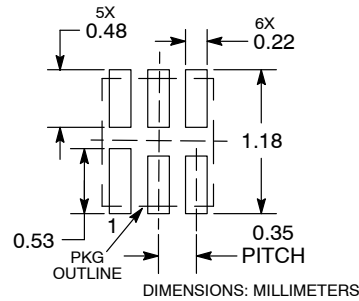
DATE 18 MAY 2011



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.20 MM FROM TERMINAL TIP.
  4. PACKAGE DIMENSIONS EXCLUSIVE OF BURRS AND MOLD FLASH.

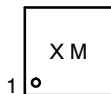
| MILLIMETERS |      |      |
|-------------|------|------|
| DIM         | MIN  | MAX  |
| A           | 0.45 | 0.55 |
| A1          | 0.00 | 0.05 |
| A3          | 0.13 | REF  |
| b           | 0.12 | 0.22 |
| D           | 1.00 | BSC  |
| E           | 1.00 | BSC  |
| e           | 0.35 | BSC  |
| L           | 0.25 | 0.35 |
| L1          | 0.30 | 0.40 |

### RECOMMENDED SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

### GENERIC MARKING DIAGRAM\*



X = Specific Device Code  
M = Date Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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