

# NLU1G00

## Single 2-Input NAND Gate

The NLU1G00 MiniGate™ is an advanced high-speed CMOS 2-input NAND gate in ultra-small footprint.

The NLU1G00 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

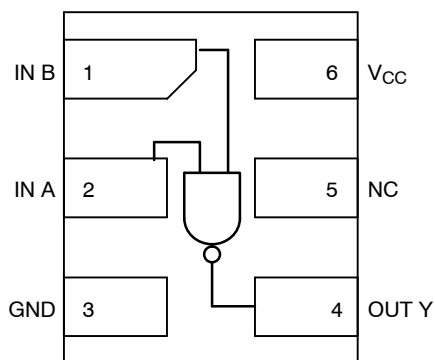


Figure 1. Pinout (Top View)

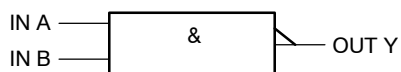


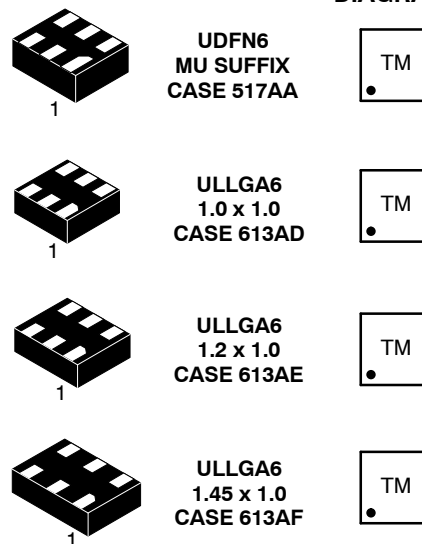
Figure 2. Logic Symbol



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### MARKING DIAGRAMS



T = Device Marking  
M = Date Code

### PIN ASSIGNMENT

|   |          |
|---|----------|
| 1 | IN B     |
| 2 | IN A     |
| 3 | GND      |
| 4 | OUT Y    |
| 5 | NC       |
| 6 | $V_{CC}$ |

### FUNCTION TABLE

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

### ORDERING INFORMATION

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

# NLU1G00

## 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>$V_{OUT} < GND$                         | ±20                  | mA   |
| $I_O$         | DC Output Source/Sink Current                                      | ±12.5                | mA   |
| $I_{CC}$      | DC Supply Current Per Supply Pin                                   | ±25                  | mA   |
| $I_{GND}$     | DC Ground Current per Ground Pin                                   | ±25                  | mA   |
| $T_{STG}$     | Storage Temperature Range                                          | -65 to +150          | °C   |
| $T_L$         | Lead Temperature, 1 mm from Case for 10 Seconds                    | 260                  | °C   |
| $T_J$         | Junction Temperature Under Bias                                    | 150                  | °C   |
| MSL           | Moisture Sensitivity                                               | Level 1              |      |
| $F_R$         | Flammability Rating<br>Oxygen Index: 28 to 34                      | UL 94 V-0 @ 0.125 in |      |
| $I_{LATCHUP}$ | Latchup Performance Above $V_{CC}$ and Below GND at 125°C (Note 2) | ±500                 | mA   |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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      | °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 |

DC ELECTRICAL CHARACTERISTICS

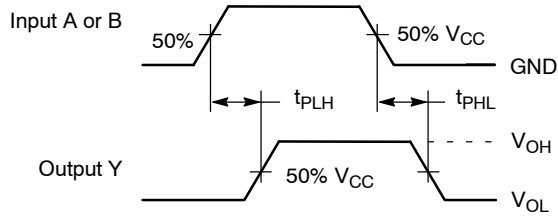
| Symbol          | Parameter                 | Conditions                                                                                                 | V <sub>CC</sub><br>(V) | T <sub>A</sub> = 25 °C |                   |                        | T <sub>A</sub> = +85°C |                        | 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   |

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

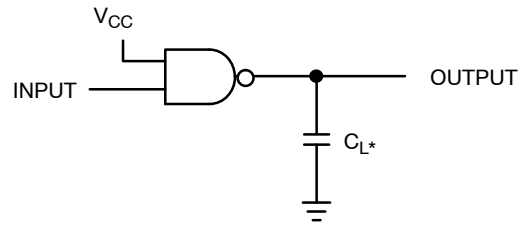
| Symbol                                 | Parameter                                         | V <sub>CC</sub><br>(V) | Test Condition         | T <sub>A</sub> = 25 °C |     |      | T <sub>A</sub> = +85°C |      | T <sub>A</sub> = -55°C to +125°C |      | Unit |
|----------------------------------------|---------------------------------------------------|------------------------|------------------------|------------------------|-----|------|------------------------|------|----------------------------------|------|------|
|                                        |                                                   |                        |                        | Min                    | Typ | Max  | Min                    | Max  | Min                              | Max  |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Propagation Delay,<br>Input A or B to<br>Output Y | 3.0 to 3.6             | C <sub>L</sub> = 15 pF |                        | 4.1 | 8.8  |                        | 10.5 |                                  | 12.5 | ns   |
|                                        |                                                   |                        | C <sub>L</sub> = 50 pF |                        | 5.9 | 12.3 |                        | 14   |                                  | 16.5 |      |
|                                        |                                                   | 4.5 to 5.5             | C <sub>L</sub> = 15 pF |                        | 3.5 | 5.9  |                        | 7.0  |                                  | 9.0  |      |
|                                        |                                                   |                        | C <sub>L</sub> = 50 pF |                        | 4.2 | 7.9  |                        | 9.0  |                                  | 11   |      |
| C <sub>IN</sub>                        | Input Capacitance                                 |                        |                        |                        | 5.5 | 10   |                        | 10   |                                  | 10   | pF   |
| C <sub>PD</sub>                        | Power Dissipation Capacitance<br>(Note 3)         | 5.0                    |                        |                        | 11  |      |                        |      |                                  |      | 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>.

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**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

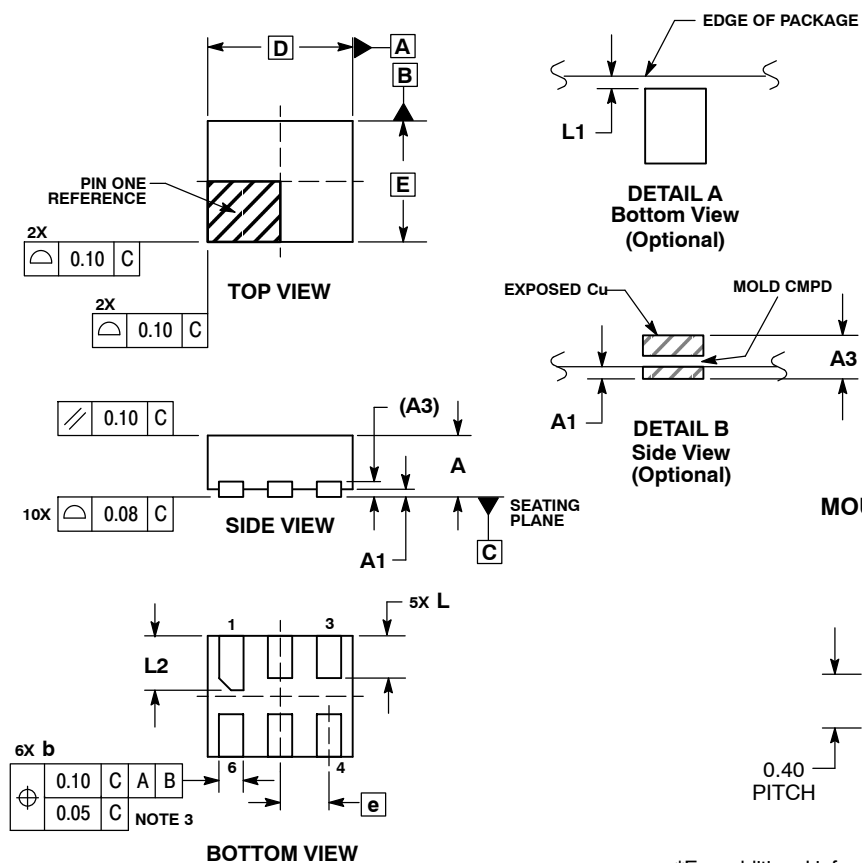
| Device         | Package                         | Shipping <sup>†</sup> |
|----------------|---------------------------------|-----------------------|
| NLU1G00MUTCG   | UDFN6<br>(Pb-Free)              | 3000 / Tape & Reel    |
| NLU1G00AMX1TCG | ULLGA6, 1.45 x 1.0<br>(Pb-Free) | 3000 / Tape & Reel    |
| NLU1G00BMX1TCG | ULLGA6, 1.2 x 1.0<br>(Pb-Free)  | 3000 / Tape & Reel    |
| NLU1G00CMX1TCG | ULLGA6, 1.0 x 1.0<br>(Pb-Free)  | 3000 / 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.

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## PACKAGE DIMENSIONS

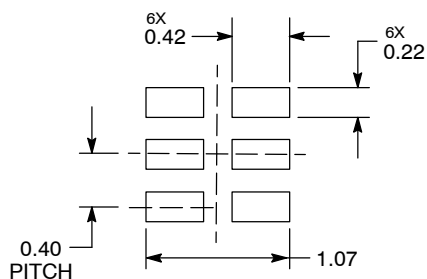
UDFN6, 1.2x1.0, 0.4P  
CASE 517AA-01  
ISSUE C



- 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 |

### MOUNTING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

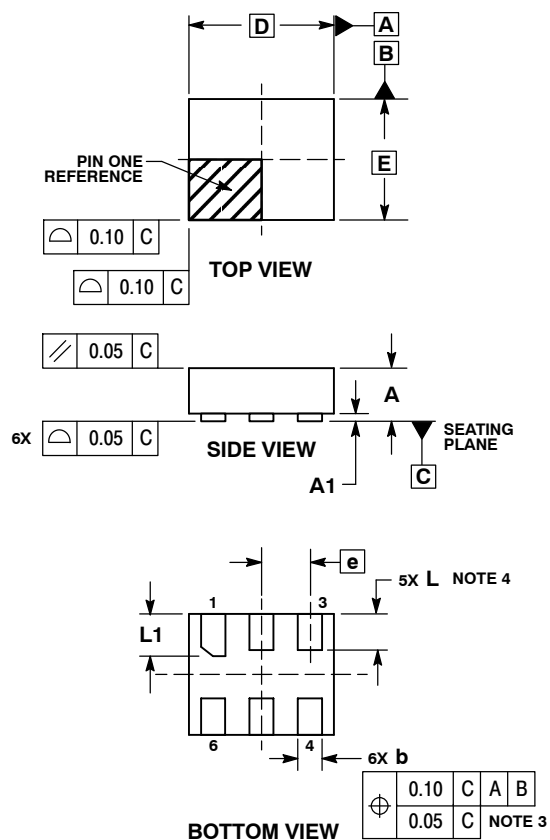
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



# NLU1G00

## PACKAGE DIMENSIONS

ULLGA6 1.2x1.0, 0.4P  
CASE 613AE-01  
ISSUE A

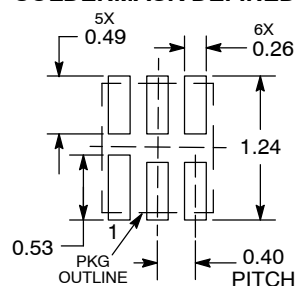


### NOTES:

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.
4. A MAXIMUM OF 0.05 PULL BACK OF THE PLATED TERMINAL FROM THE EDGE OF THE PACKAGE IS ALLOWED.

| MILLIMETERS |          |      |
|-------------|----------|------|
| DIM         | MIN      | MAX  |
| A           | ---      | 0.40 |
| A1          | 0.00     | 0.05 |
| b           | 0.15     | 0.25 |
| D           | 1.20 BSC |      |
| E           | 1.00 BSC |      |
| e           | 0.40 BSC |      |
| L           | 0.25     | 0.35 |
| L1          | 0.35     | 0.45 |

### MOUNTING FOOTPRINT SOLDERMASK DEFINED\*



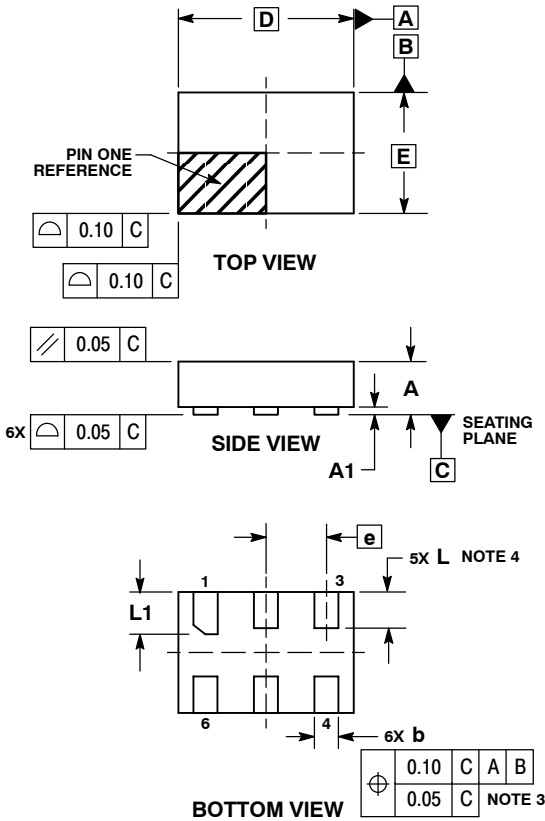
DIMENSIONS: MILLIMETERS

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

# NLU1G00

## PACKAGE DIMENSIONS

ULLGA6 1.45x1.0, 0.5P  
CASE 613AF-01  
ISSUE A

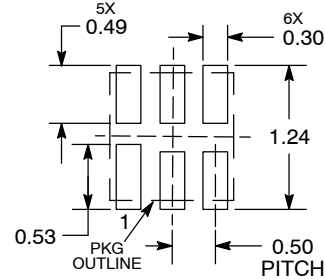


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4. A MAXIMUM OF 0.05 PULL BACK OF THE PLATED TERMINAL FROM THE EDGE OF THE PACKAGE IS ALLOWED.

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | ---         | 0.40 |
| A1  | 0.00        | 0.05 |
| b   | 0.15        | 0.25 |
| D   | 1.45        | BSC  |
| E   | 1.00        | BSC  |
| e   | 0.50        | BSC  |
| L   | 0.25        | 0.35 |
| L1  | 0.30        | 0.40 |

### MOUNTING FOOTPRINT SOLDERMASK DEFINED\*



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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