# NLU1G86

# Single 2-Input Exclusive OR Gate

The NLU1G86 MiniGate™ is an advanced high−speed CMOS 2−input Exclusive OR gate in ultra−small footprint.

The NLU1G86 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 ns (Typ) @ $V_{CC}$ = 5.0 V
- Low Power Dissipation: $I_{CC}$ = 1 μA (Max) at $T_A$ = 25°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

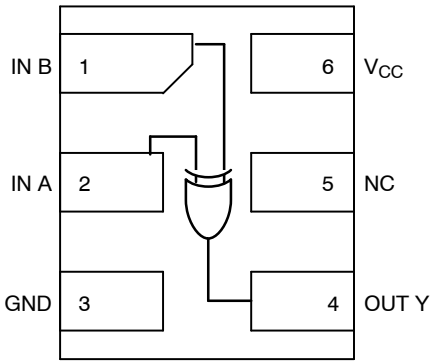


**Figure 1. Pinout** (Top View)

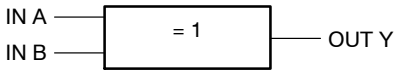


**Figure 2. Logic Symbol**

**PIN ASSIGNMENT**

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

**FUNCTION TABLE**

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

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**MARKING DIAGRAMS**

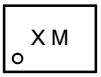

**UDFN6**
**1.0 x 1.0**
**CASE 517BX**



**UDFN6**
**1.2 x 1.0**
**CASE 517AA**



**UDFN6**
**1.45 x 1.0**
**CASE 517AQ**




4 = Device Marking
M = Date Code

**ORDERING INFORMATION**

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

## 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 | $V_{IN}$ < GND | −20 | mA |
| $I_{OK}$ | DC Output Diode Current | $V_{OUT}$ < 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 | Oxygen Index: 28 to 34 | UL 94 V−0 @ 0.125 in | |
| $V_{ESD}$ | ESD Withstand Voltage | Human Body Model (Note 2)<br>Machine Model (Note 3)<br>Charged Device Model (Note 4) | > 2000<br>> 200<br>N/A | V |
| $I_{LATCHUP}$ | Latchup Performance Above $V_{CC}$ and Below GND at 125°C (Note 5) | | ±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 / JESD22−A114−A.
3. Tested to EIA / JESD22−A115−A.
4. Tested to JESD22−C101−A.
5. 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 | $V_{CC}$ = 3.3 V ± 0.3 V<br>$V_{CC}$ = 5.0 V ± 0.5 V | 0<br>0 | 100<br>20 | ns/V |

## DC ELECTRICAL CHARACTERISTICS

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

## AC ELECTRICAL CHARACTERISTICS (Input $t_r$ = $t_f$ = 3.0 nS)

| Symbol | Parameter | $V_{CC}$ (V) | Test Condition | $T_A$ = 25 °C | | | $T_A$ = +85°C | | $T_A$ = −55°C to +125°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| $t_{PLH}$, $t_{PHL}$ | Propagation Delay, Input A or B to Output Y | 3.0 to 3.6 | $C_L$ = 15 pF | | 4.4 | 11 | | 13 | | 15.5 | ns |
| | | | $C_L$ = 50 pF | | 5.7 | 14.5 | | 16.5 | | 19.5 | |
| | | 4.5 to 5.5 | $C_L$ = 15 pF | | 3.5 | 6.8 | | 8.0 | | 10 | |
| | | | $C_L$ = 50 pF | | 4.2 | 8.8 | | 10 | | 12 | |
| $C_{IN}$ | Input Capacitance | | | | 5.5 | 10 | | 10 | | 10 | pF |
| $C_{PD}$ | Power Dissipation Capacitance (Note 6) | 5.0 | | | 10 | | | | | | pF |

6. $C_{PD}$ 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 $I_{CC(OPR)}$ = $C_{PD}$ • $V_{CC}$ • $f_{in}$ + $I_{CC}$. $C_{PD}$ is used to determine the no−load dynamic power consumption: $P_D$ = $C_{PD}$ • $V_{CC}^2$ • $f_{in}$ + $I_{CC}$ • $V_{CC}$.

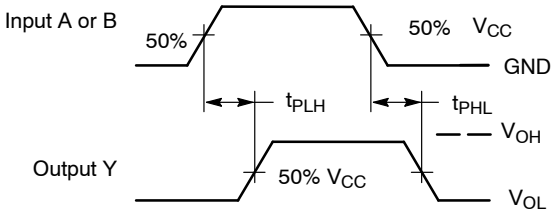
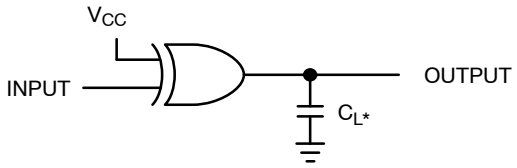



**Figure 3. Switching Waveforms**




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

**Figure 4. Test Circuit**

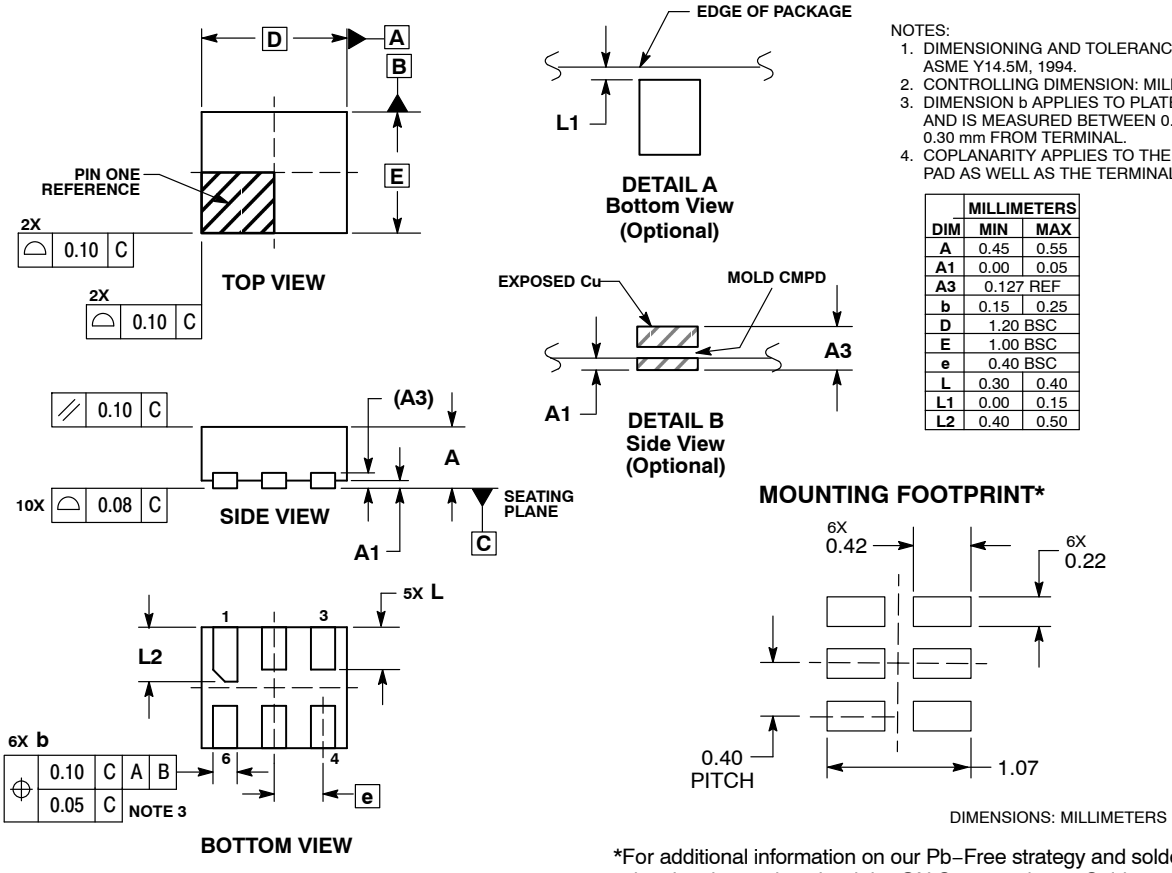
## ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| NLU1G86AMUTCG | UDFN6, 1.45 x 1.0, 0.5P (Pb−Free) | 3000 / Tape & Reel |
| NLU1G86MUTCG | UDFN6, 1.2 x 1.0, 0.4P (Pb−Free) | 3000 / Tape & Reel |
| NLU1G86CMUTCG | UDFN6, 1.0 x 1.0, 0.35P (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.

## PACKAGE DIMENSIONS

**UDFN6, 1.2x1.0, 0.4P**
CASE 517AA
ISSUE D



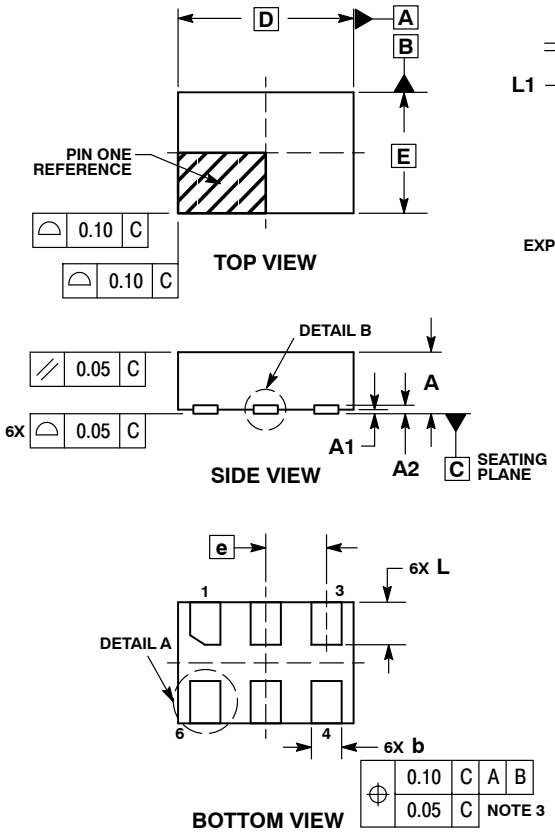

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 mm FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

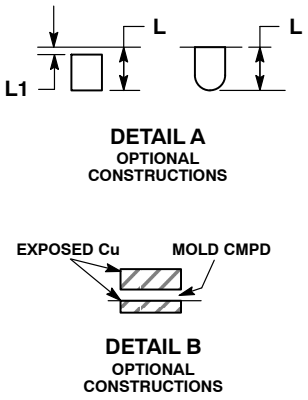
| | MILLIMETERS | |
|---|---|---|
| DIM | MIN | MAX |
| A | 0.45 | 0.55 |
| A1 | 0.00 | 0.05 |
| A3 | 0.127 REF | |
| b | 0.15 | 0.25 |
| D | 1.20 BSC | |
| E | 1.00 BSC | |
| e | 0.40 BSC | |
| L | 0.30 | 0.40 |
| L1 | 0.00 | 0.15 |
| L2 | 0.40 | 0.50 |

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

## PACKAGE DIMENSIONS

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

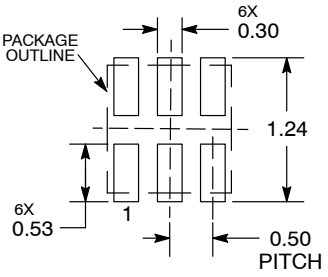



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 mm FROM THE TERMINAL TIP.

| | 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

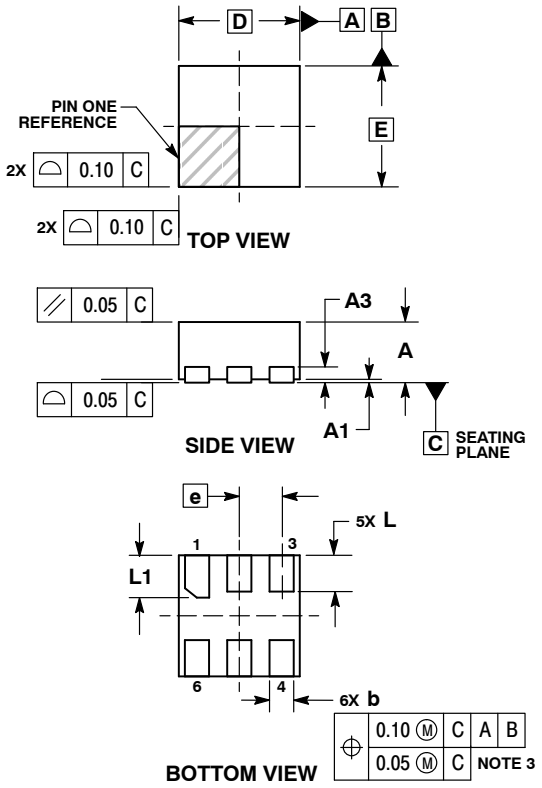



DIMENSIONS: MILLIMETERS

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

## PACKAGE DIMENSIONS

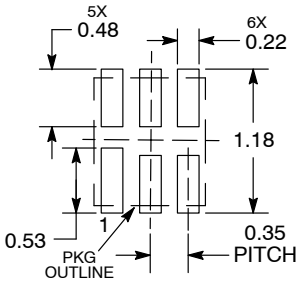
**UDFN6 1.0x1.0, 0.35P**
CASE 517BX
ISSUE O




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*




DIMENSIONS: MILLIMETERS

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