# NLX1G97

# Configurable Multifunction Gate

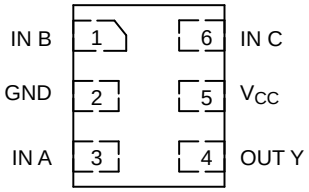
The NLX1G97 MiniGate™ is an advanced high−speed CMOS multifunction gate. The device allows the user to choose logic functions MUX, AND, OR, NAND, NOR, INVERT and BUFFER. The device has Schmitt−trigger inputs, thereby enhancing noise immunity.

The NLX1G97 input and output structures provide protection when voltages up to 7.0 V are applied, regardless of the supply voltage.

### Features

- High Speed: $t_{PD}$ = 3.3 ns (Typ) @ $V_{CC}$ = 5.0 V
- Low Power Dissipation: $I_{CC}$ = 1 μA (Maximum) 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

### PIN ASSIGNMENTS




(Top View)

**ON Semiconductor®**

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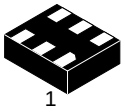
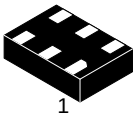
### MARKING DIAGRAMS


**ULLGA6**
**1.0 x 1.0**
**CASE 613AD**


**ULLGA6**
**1.2 x 1.0**
**CASE 613AE**


**ULLGA6**
**1.45 x 1.0**
**CASE 613AF**



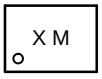
**UDFN6**
**1.0 x 1.0**
**CASE 517BX**



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



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




F = Specific Device Code
M = Date Code

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

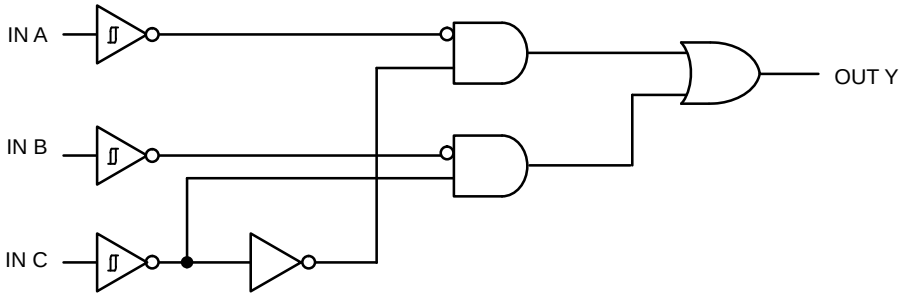



**Figure 1. Function Diagram**

**PIN ASSIGNMENT**

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

**FUNCTION TABLE***

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

*To select a logic function, please refer to “Logic Configurations section”.

## LOGIC CONFIGURATIONS

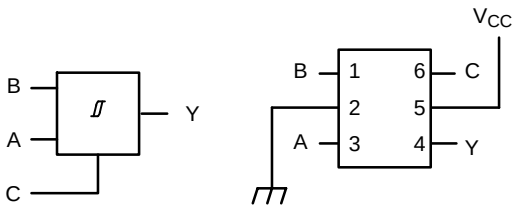



**Figure 2. 2−Input MUX**

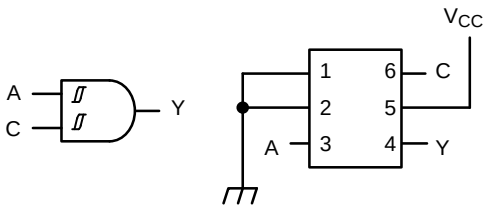



**Figure 3. 2−Input AND (When B = “L”)**

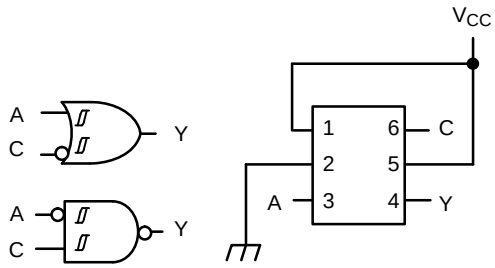



**Figure 4. 2−Input OR with Input C Inverted (When B = “H”)**

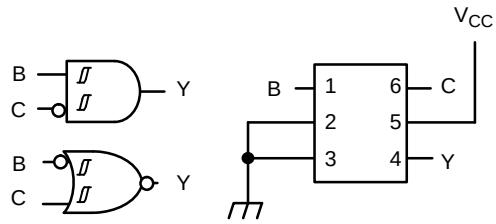



**Figure 5. 2−Input AND with Input C Inverted (When A = “L”)**

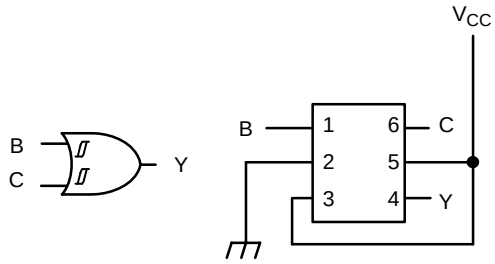



**Figure 6. 2−Input OR (When A =”H”)**

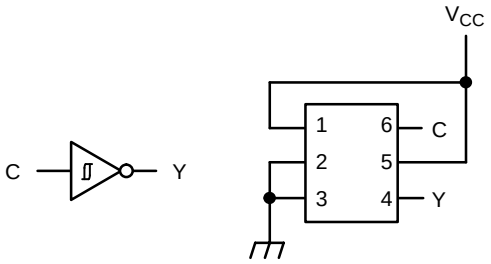



**Figure 7. Inverter (When A = “L” and B = “H”)**

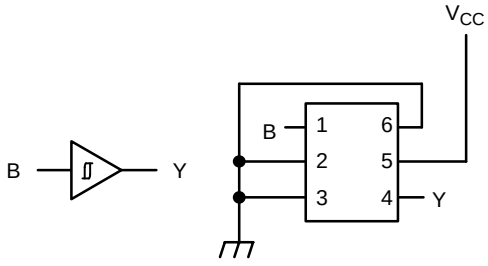



**Figure 8. Buffer (When A = C = “L”)**

## 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 | −50 | mA |
| $I_{OK}$ | DC Output Diode Current | $V_{OUT}$ < GND | −50 | mA |
| $I_O$ | DC Output Source/Sink Current | | ±50 | mA |
| $I_{CC}$ | DC Supply Current Per Supply Pin | | ±100 | mA |
| $I_{GND}$ | DC Ground Current per Ground Pin | | ±100 | 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 | $V_{CC}$ = 2.5 V ± 0.2 V<br>$V_{CC}$ = 3.3 V ± 0.3 V<br>$V_{CC}$ = 5.0 V ± 0.5 V | 0<br>0<br>0 | No Limit<br>No LImit<br>No Limit | nS/V |

## DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | $T_A$ = 25°C | | | $T_A \leq$ +85°C | | $T_A$ = −55°C to +125°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| $V_{T+}$ | Positive Threshold Voltage | | 1.65 | 0.79 | | 1.16 | | 1.16 | | 1.16 | V |
| | | | 2.3 | 1.11 | | 1.56 | | 1.56 | | 1.56 | |
| | | | 3.0 | 1.5 | | 1.87 | | 1.87 | | 1.87 | |
| | | | 4.5 | 2.16 | | 2.74 | | 2.74 | | 2.74 | |
| | | | 5.5 | 2.61 | | 3.33 | | 3.33 | | 3.33 | |
| $V_{T-}$ | Negative Threshold Voltage | | 1.65 | 0.35 | | 0.62 | 0.35 | | 0.35 | | V |
| | | | 2.3 | 0.58 | | 0.87 | 0.58 | | 0.58 | | |
| | | | 3.0 | 0.84 | | 1.19 | 0.84 | | 0.84 | | |
| | | | 4.5 | 1.41 | | 1.9 | 1.41 | | 1.41 | | |
| | | | 5.5 | 1.78 | | 2.29 | 1.78 | | 1.78 | | |
| $V_H$ | Hysteresis Voltage | | 1.65 | 0.30 | | 0.62 | 0.30 | 0.62 | 0.30 | 0.62 | V |
| | | | 2.3 | 0.40 | | 0.8 | 0.40 | 0.8 | 0.40 | 0.8 | |
| | | | 3.0 | 0.53 | | 0.87 | 0.53 | 0.87 | 0.53 | 0.87 | |
| | | | 4.5 | 0.71 | | 1.04 | 0.71 | 1.04 | 0.71 | 1.04 | |
| | | | 5.5 | 0.8 | | 1.2 | 0.8 | 1.2 | 0.8 | 1.2 | |
| $V_{OH}$ | Minimum High−Level Output Voltage | $V_{IN} = V_{T-MIN}$ or $V_{T+MAX}$<br>$I_{OH}$ = −50 μA | 1.65 − 5.5 | $V_{CC}$ − 0.1 | | | $V_{CC}$ − 0.1 | | $V_{CC}$ − 0.1 | | V |
| | | $V_{IN} = V_{T-MIN}$ or $V_{T+MAX}$ | | | | | | | | | |
| | | $I_{OH}$ = −4 mA | 1.65 | 1.2 | | | 1.2 | | 1.2 | | |
| | | $I_{OH}$ = −8 mA | 2.3 | 1.9 | | | 1.9 | | 1.9 | | |
| | | $I_{OH}$ = −16 mA | 3.0 | 2.4 | | | 2.4 | | 2.4 | | |
| | | $I_{OH}$ = −24 mA | 3.0 | 2.3 | | | 2.3 | | 2.3 | | |
| | | $I_{OH}$ = −32 mA | 4.5 | 3.8 | | | 3.8 | | 3.8 | | |
| $V_{OL}$ | Maximum Low−Level Output Voltage | $V_{IN} = V_{T-MIN}$ or $V_{T+MAX}$<br>$I_{OL}$ = 50 μA | 1.65 − 5.5 | | | 0.1 | | 0.1 | | 0.1 | V |
| | | $V_{IN} = V_{T-MIN}$ or $V_{T+MAX}$ | | | | | | | | | |
| | | $I_{OL}$ = 4 mA | 1.65 | | | 0.45 | | 0.45 | | 0.45 | |
| | | $I_{OL}$ = 8 mA | 2.3 | | | 0.3 | | 0.3 | | 0.3 | |
| | | $I_{OL}$ = 16 mA | 3.0 | | | 0.4 | | 0.4 | | 0.4 | |
| | | $I_{OL}$ = 24 mA | 3.0 | | | 0.55 | | 0.55 | | 0.55 | |
| | | $I_{OL}$ = 32 mA | 4.5 | | | 0.55 | | 0.55 | | 0.55 | |
| $I_{IN}$ | Input Leakage Current | $0 \leq V_{IN} \leq 5.5$ V | 0 to 5.5 | | | ±0.1 | | ±1.0 | | ±1.0 | μA |
| $I_{CC}$ | Quiescent Supply Current | $V_{IN} = V_{CC}$ or GND | 5.5 | | | 1.0 | | 10 | | 10 | μA |

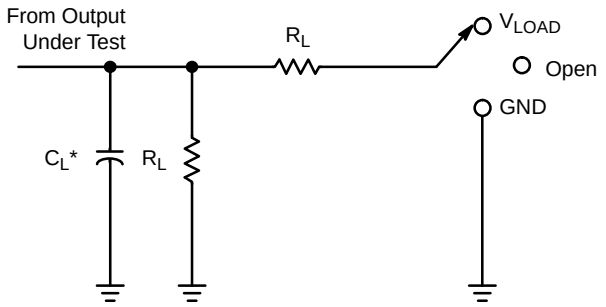
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

**AC ELECTRICAL CHARACTERISTICS** (Input $t_r = t_f = 3.0$ ns)

| Symbol | Parameter | $V_{CC}$ (V) | Test Condition | $T_A$ = 25°C | | | $T_A \leq$ +85°C | | $T_A$ = −55°C to +125°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| $t_{PLH}$, $t_{PHL}$ | Propagation Delay, Any Input to Output Y (See Test Circuit) | 1.65 − 1.95 | | 3.2 | 8.6 | 14.4 | 3.2 | 14.4 | 3.2 | 14.4 | ns |
| | | 2.3 − 2.7 | | 2.0 | 5.1 | 8.3 | 2.0 | 8.3 | 2.0 | 8.3 | |
| | | 3.0 − 3.6 | | 1.5 | 3.9 | 6.3 | 1.5 | 6.3 | 1.5 | 6.3 | |
| | | 4.5 − 5.5 | | 1.1 | 3.3 | 5.1 | 1.1 | 5.1 | 1.1 | 5.1 | |
| $C_{IN}$ | Input Capacitance | | | | 3.5 | | | | | | pF |
| $C_{PD}$ | Power Dissipation Capacitance (Note 6) | 5.0 | f = 10 MHz | | 22 | | | | | | 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 $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}$. $C_{PD}$ is used to determine the no−load dynamic power consumption: $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}$.

## TEST CIRCUIT AND VOLTAGE WAVEFORMS




*$C_L$ includes probes and jig capacitance.

**Figure 9. Load Circuit**

| Test | S1 |
|---|---|
| $t_{PLH}/t_{PHL}$ | Open |
| $t_{PLZ}/t_{PZL}$ | $V_{LOAD}$ |
| $t_{PHZ}/t_{PZH}$ | GND |

| $V_{CC}$ | Inputs | | $V_M$ | $V_{LOAD}$ | $C_L$ | $R_L$ | $V_\Delta$ |
|---|---|---|---|---|---|---|---|
| | $V_I$ | $t_r/t_f$ | | | | | |
| 1.8 V ± 0.15 V | $V_{CC}$ | ≤ 2 ns | $V_{CC}/2$ | 2 x $V_{CC}$ | 30 pF | 1 kΩ | 0.15 V |
| 2.5 V ± 0.2 V | $V_{CC}$ | ≤ 2 ns | $V_{CC}/2$ | 2 x $V_{CC}$ | 30 pF | 500 Ω | 0.15 V |
| 3.3 V ± 0.3 V | 3 V | ≤ 2.5 ns | 1.5 V | 6 V | 50 pF | 500 Ω | 0.3 V |
| 5.5 V ± 0.5 V | $V_{CC}$ | ≤ 2.5 ns | $V_{CC}/2$ | 2 x $V_{CC}$ | 50 pF | 500 Ω | 0.3 V |

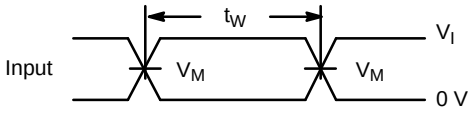



**Figure 10. Voltage Waveforms Pulse Duration**

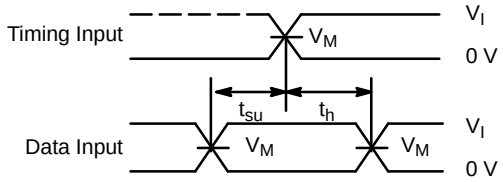



**Figure 11. Voltage Waveforms Setup and Hold Times**

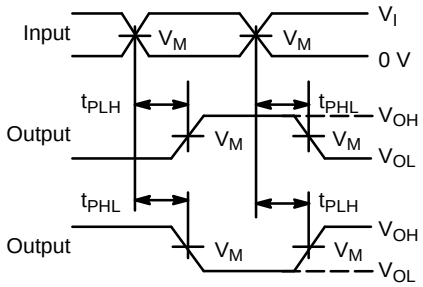



**Figure 12. Voltage Waveforms Propagation Delay Times Inverting and Noninverting Outputs**

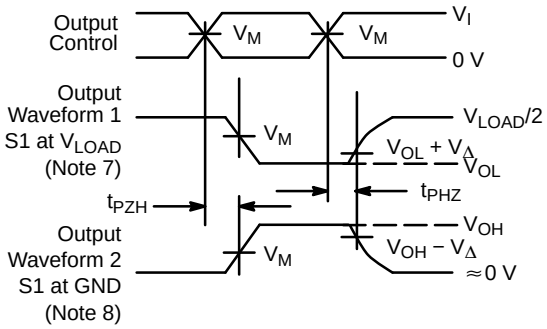



**Figure 13. Voltage Waveforms Enable and Disable Times Low− and High−Level Enabling**

7. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control.
8. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control
9. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, $Z_O$ = 50 Ω.
10. The outputs are measured one at a time, with one transition per measurement.
11. All parameters are waveforms are not applicable to all devices.

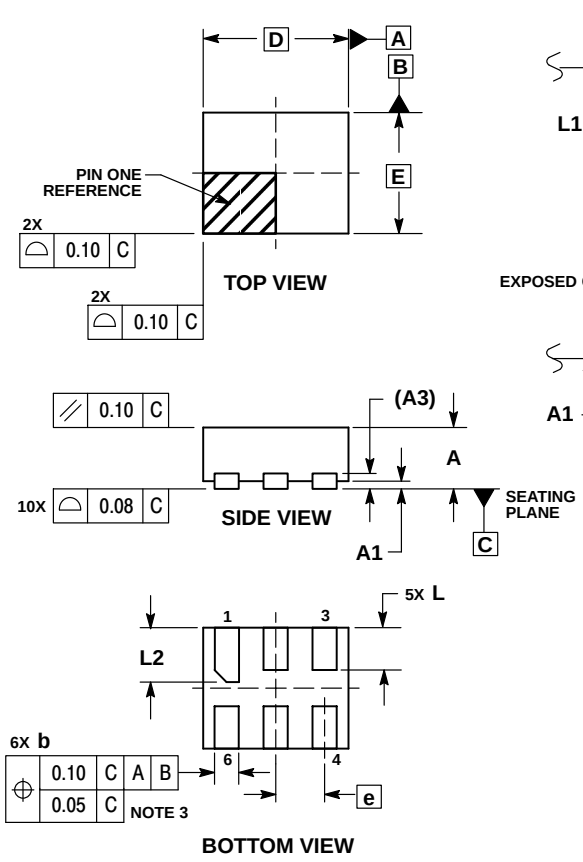
## ORDERING INFORMATION

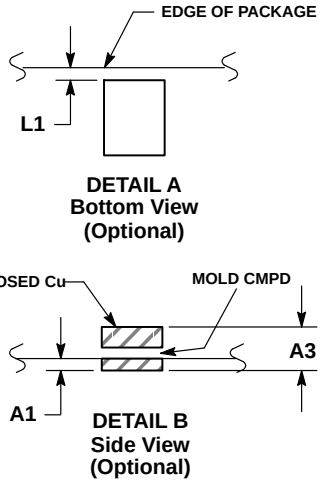
| Device | Package | Shipping† |
|---|---|---|
| NLX1G97AMX1TCG | ULLGA6 − 0.5P (Pb−Free) | 3000 / Tape & Reel |
| NLX1G97BMX1TCG | ULLGA6 − 0.4P (Pb−Free) | 3000 / Tape & Reel |
| NLX1G97CMX1TCG | ULLGA6 − 0.35P (Pb−Free) | 3000 / Tape & Reel |
| NLX1G97MUTCG | UDFN6, 1.2 x 1.0, 0.4P (Pb−Free) | 3000 / Tape & Reel |
| NLX1G97AMUTCG (In Development) | UDFN6, 1.45 x 1.0, 0.5P (Pb−Free) | 3000 / Tape & Reel |
| NLX1G97CMUTCG (In Development) | 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 O

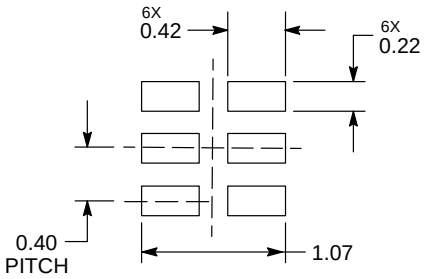



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 mm FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| | 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***

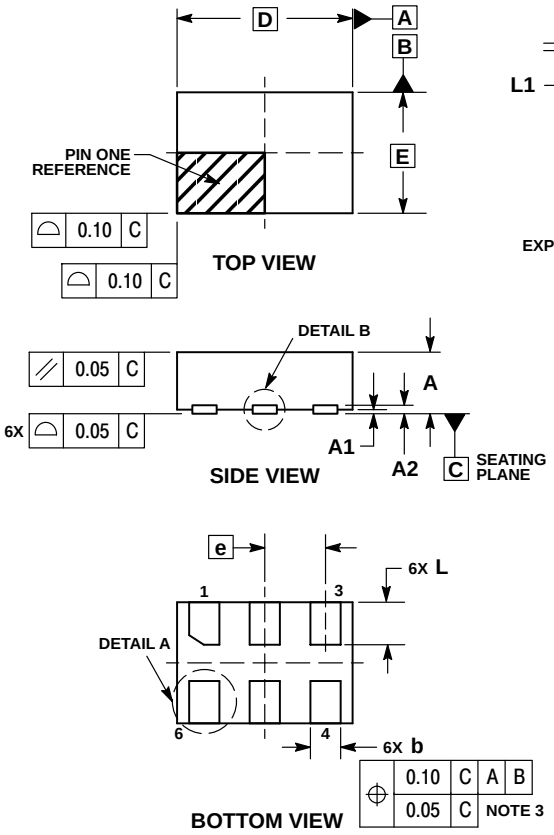


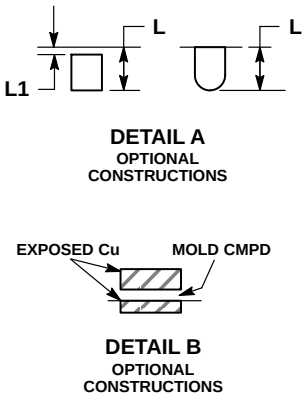

DIMENSIONS: MILLIMETERS

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

## PACKAGE DIMENSIONS

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

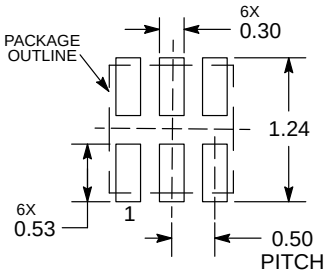



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 mm FROM THE TERMINAL TIP.

| | 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

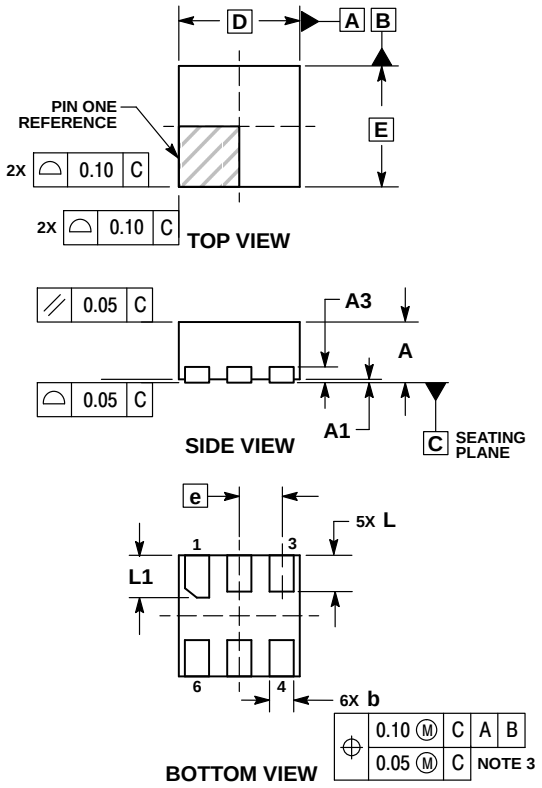



DIMENSIONS: MILLIMETERS

*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

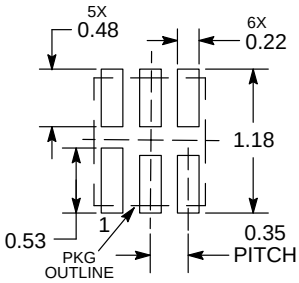
**UDFN6 1.0x1.0, 0.35P**
CASE 517BX
ISSUE O




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*

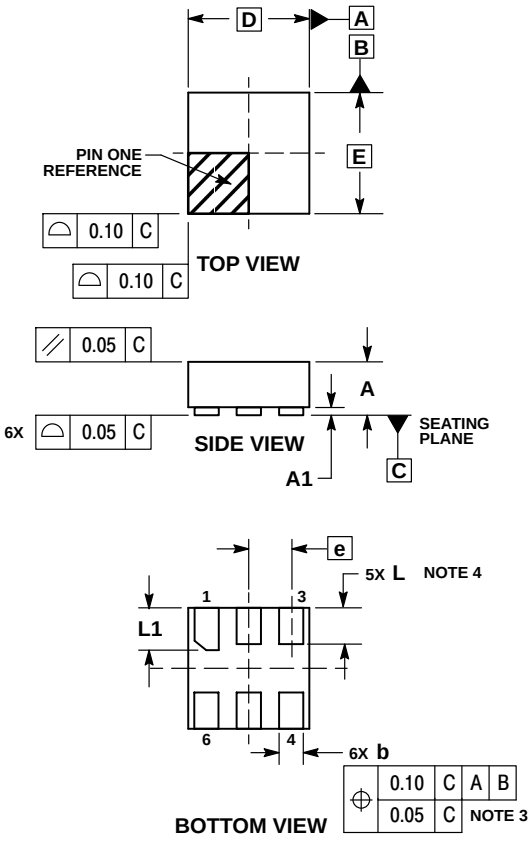



DIMENSIONS: MILLIMETERS

*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

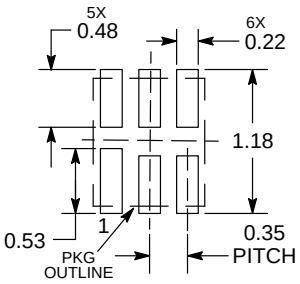
**ULLGA6 1.0x1.0, 0.35P**
CASE 613AD
ISSUE A




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 | 0.12 | 0.22 |
| D | 1.00 BSC | |
| E | 1.00 BSC | |
| e | 0.35 BSC | |
| L | 0.25 | 0.35 |
| L1 | 0.30 | 0.40 |

### MOUNTING FOOTPRINT SOLDERMASK DEFINED*




DIMENSIONS: MILLIMETERS

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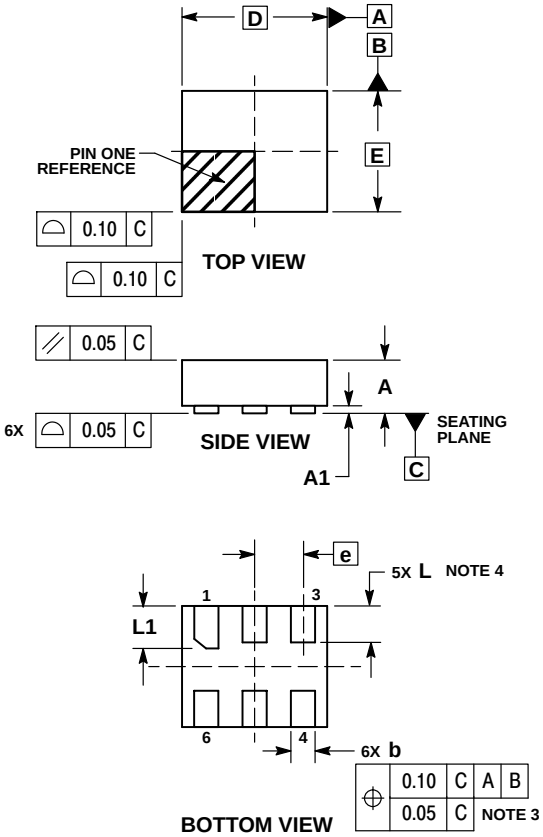
## PACKAGE DIMENSIONS

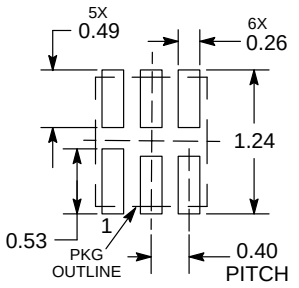
**ULLGA6 1.2x1.0, 0.4P**
CASE 613AE
ISSUE A




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

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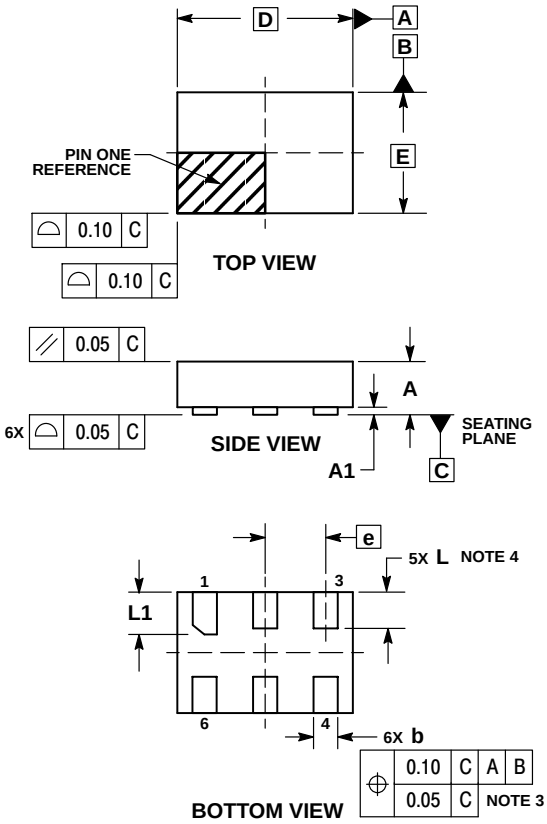
## PACKAGE DIMENSIONS

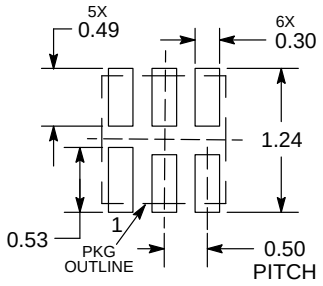
**ULLGA6 1.45x1.0, 0.5P**
CASE 613AF
ISSUE A




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 | 1.45 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

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