

# NLU1G04

## Single Inverter

The NLU1G04 MiniGate™ is an advanced high-speed CMOS inverter in ultra-small footprint.

The NLU1G04 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

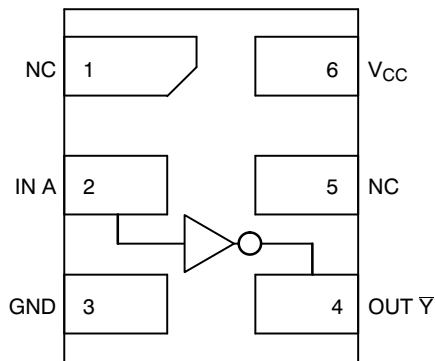


Figure 1. Pinout (Top View)

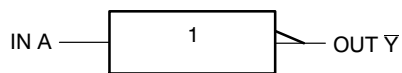


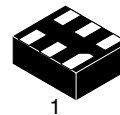
Figure 2. Logic Symbol



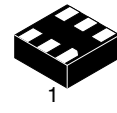
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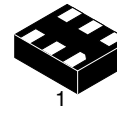
### MARKING DIAGRAMS



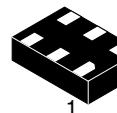
UDFN6  
MU SUFFIX  
CASE 517AA



ULLGA6  
1.0 x 1.0  
CASE 613AD



ULLGA6  
1.2 x 1.0  
CASE 613AE



ULLGA6  
1.45 x 1.0  
CASE 613AF



R = Device Marking  
M = Date Code

### PIN ASSIGNMENT

1	NC
2	IN A
3	GND
4	OUT $\bar{Y}$
5	NC
6	$V_{CC}$

### FUNCTION TABLE

A	Y
L	H
H	L

### ORDERING INFORMATION

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

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## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	DC Supply Voltage	-0.5 to +7.0	V
V <sub>IN</sub>	DC Input Voltage	-0.5 to +7.0	V
V <sub>OUT</sub>	DC Output Voltage	-0.5 to +7.0	V
I <sub>IK</sub>	DC Input Diode Current V <sub>IN</sub> < GND	-20	mA
I <sub>OK</sub>	DC Output Diode Current V <sub>OUT</sub> < GND	±20	mA
I <sub>O</sub>	DC Output Source/Sink Current	±12.5	mA
I <sub>CC</sub>	DC Supply Current Per Supply Pin	±25	mA
I <sub>GND</sub>	DC Ground Current per Ground Pin	±25	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
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 Human Body Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4)	> 2000 > 200 N/A	V
I <sub>LATCHUP1</sub>	Latchup Performance Above V <sub>CC</sub> and Below GND at 125 °C (Note 5)	±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 / 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 <sub>CC</sub>	Positive DC Supply Voltage	1.65	5.5	V
V <sub>IN</sub>	Digital Input Voltage	0	5.5	V
V <sub>OUT</sub>	Output Voltage	0	5.5	V
T <sub>A</sub>	Operating Free-Air Temperature	-55	+125	°C
Δt/ΔV	Input Transition Rise or Fall Rate V <sub>CC</sub> = 3.3 V ± 0.3 V V <sub>CC</sub> = 5.0 V ± 0.5 V	0 0	100 20	ns/V

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## DC ELECTRICAL CHARACTERISTICS

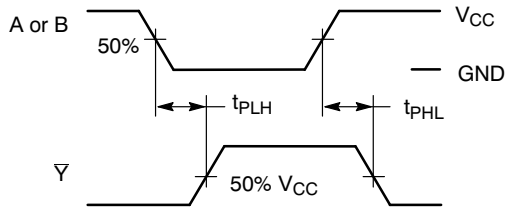
Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = 25 °C			T <sub>A</sub> = +85°C		T <sub>A</sub> = -55°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
V <sub>IH</sub>	Low-Level Input Voltage		1.65	0.75 x V <sub>CC</sub>			0.75 x V <sub>CC</sub>				V
			2.3 to 5.5	0.70 x V <sub>CC</sub>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

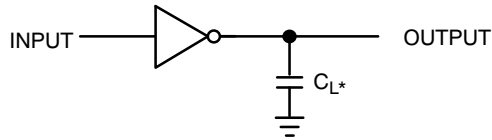
Symbol	Parameter	V <sub>CC</sub> (V)	Test Condition	T <sub>A</sub> = 25 °C			T <sub>A</sub> = +85°C		T <sub>A</sub> = -55°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t <sub>pLH</sub> , t <sub>pHL</sub>	Propagation Delay, Input A to Output Y	3.0 to 3.6	C <sub>L</sub> = 15 pF		4.5	7.1		8.5		10.0	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 6)	5.0			8.0						pF

6. 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

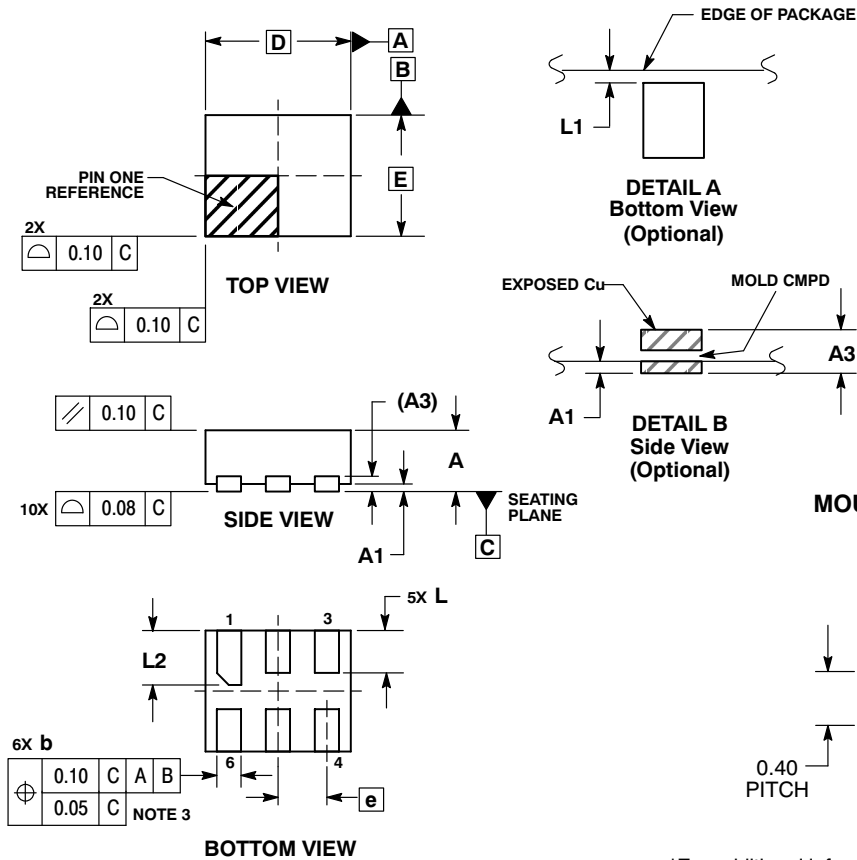
Device	Package	Shipping†
NLU1G04MUTCG	UDFN6 (Pb-Free)	3000 / Tape & Reel
NLU1G04AMX1TCG	ULLGA6, 1.45 x 1.0, 0.5P (Pb-Free)	3000 / Tape & Reel
NLU1G04BMX1TCG	ULLGA6, 1.2 x 1.0, 0.4P (Pb-Free)	3000 / Tape & Reel
NLU1G04CMX1TCG	ULLGA6, 1.0 x 1.0, 0.35P (Pb-Free)	3000 / Tape & Reel

†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.

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## PACKAGE DIMENSIONS

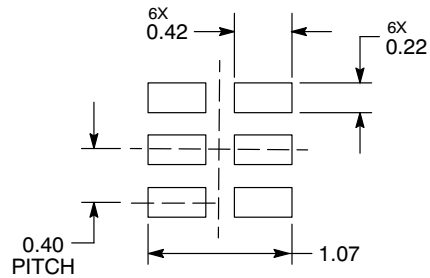
UDFN6, 1.2x1.0, 0.4P  
CASE 517AA-01  
ISSUE C



- 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\*



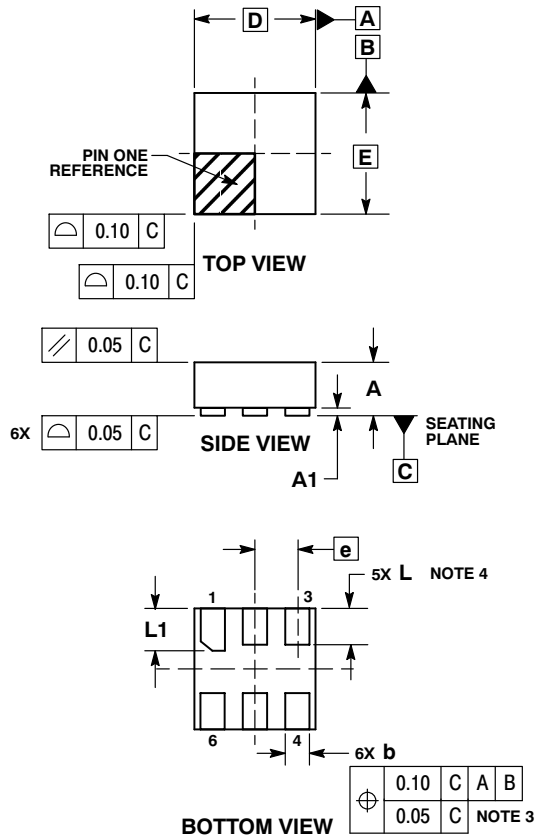
DIMENSIONS: MILLIMETERS

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

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## PACKAGE DIMENSIONS

ULLGA6 1.0x1.0, 0.35P  
CASE 613AD-01  
ISSUE A

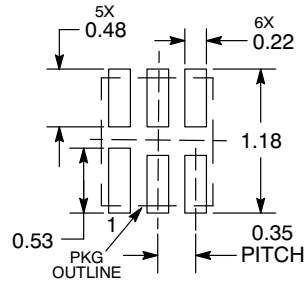


NOTES:

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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 mm 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\*



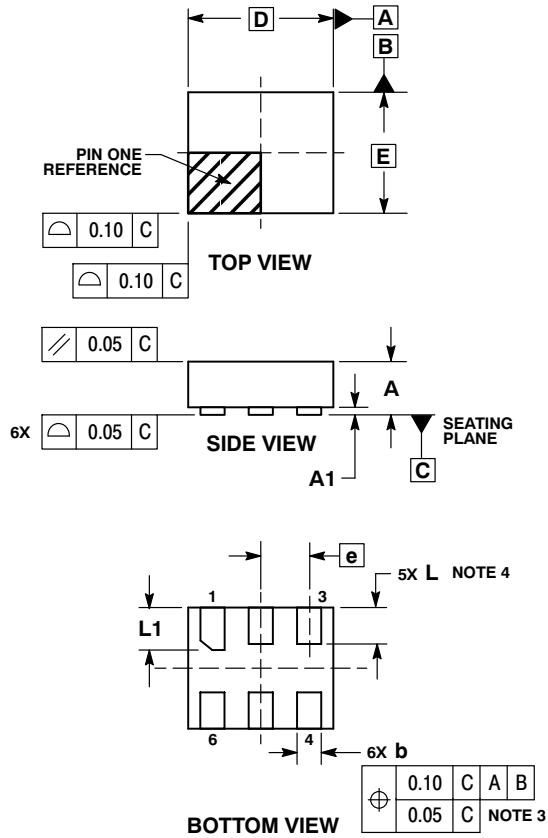
DIMENSIONS: MILLIMETERS

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## PACKAGE DIMENSIONS

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

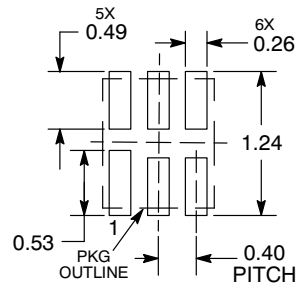


**NOTES:**

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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\*



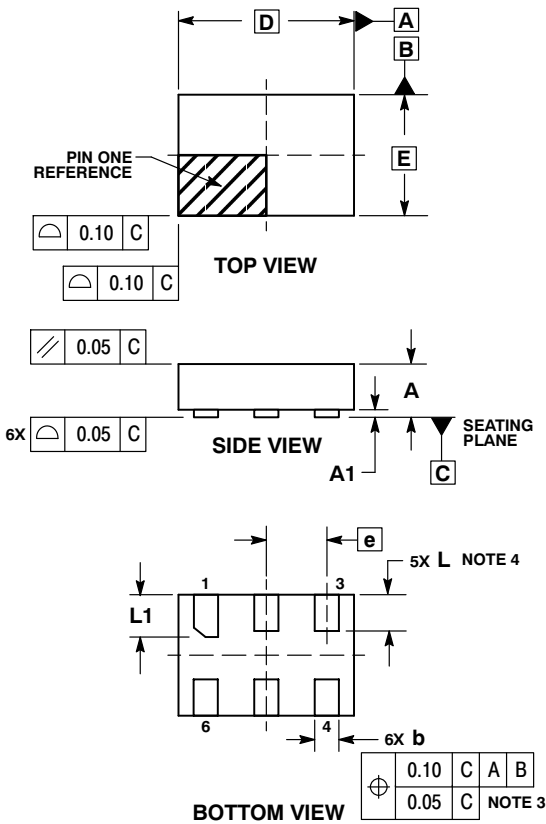
DIMENSIONS: MILLIMETERS

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## PACKAGE DIMENSIONS

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

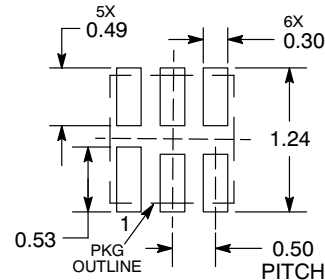


### NOTES:

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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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