

NLU1GT14

Single Schmitt-Trigger Inverter, TTL Level

LSTTL-Compatible Inputs

The NLU1GT14 MiniGate™ is an advanced high-speed CMOS Schmitt-trigger inverter in ultra-small footprint.

The device input is compatible with TTL-type input thresholds and the output has a full 5 V CMOS level output swing.

The NLU1GT14 input and output structures provide protection when voltages up to 7 V are applied, regardless of the supply voltage.

The NLU1GT14 can be used to enhance noise immunity or to square up slowly changing waveforms.

Features

- High Speed: $t_{PD} = 4.5 \text{ ns}$ (Typ) @ $V_{CC} = 5.0 \text{ V}$
- Low Power Dissipation: $I_{CC} = 1 \mu\text{A}$ (Max) at $T_A = 25^\circ\text{C}$
- TTL-Compatible Input: $V_{IL} = 0.8 \text{ V}$; $V_{IH} = 2.0 \text{ V}$
- CMOS-Compatible Output: $V_{OH} > 0.8 V_{CC}$; $V_{OL} < 0.1 V_{CC}$ @ Load
- Power Down Protection Provided on inputs
- Balanced Propagation Delays
- Overvoltage Tolerant (OVT) Input and Output Pins
- Ultra-Small Packages
- These are Pb-Free Devices

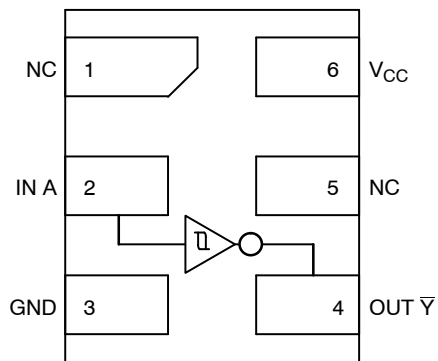


Figure 1. Pinout (Top View)

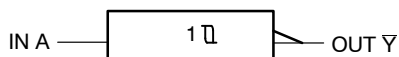


Figure 2. Logic Symbol

FUNCTION TABLE

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

PIN ASSIGNMENT

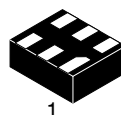
| | |
|---|---------------|
| 1 | NC |
| 2 | IN A |
| 3 | GND |
| 4 | OUT \bar{Y} |
| 5 | NC |
| 6 | V_{CC} |



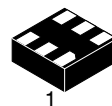
ON Semiconductor®

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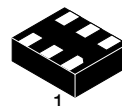
MARKING DIAGRAMS



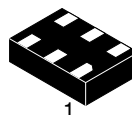
UDFN6
MU SUFFIX
CASE 517AA



ULLGA6
1.0 x 1.0
CASE 613AD



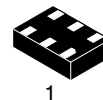
ULLGA6
1.2 x 1.0
CASE 613AE



ULLGA6
1.45 x 1.0
CASE 613AF



UDFN6
1.0 x 1.0
CASE 517BX



UDFN6
1.45 x 1.0
CASE 517AQ



M = 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.

NLU1GT14

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) Machine Model (Note 3) Charged Device Model (Note 4) | > 2000 > 150 N/A | V |
| I _{LATCHUP} | Latchup Performance Above V _{CC} 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 _{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 |
| Δt/ΔV | Input Transition Rise or Fall Rate V _{CC} = 3.3 V ± 0.3 V V _{CC} = 5.0 V ± 0.5 V | 0 0 | No Limit No Limit | ns/V |

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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 _{T+} | Positive Threshold Voltage | | 3.0 | 1.20 | 1.40 | 1.60 | | 1.6 | | 1.6 | V |
| | | | 4.5 | 1.58 | 1.74 | 2.00 | | 2.0 | | 2.0 | |
| | | | 5.5 | 1.79 | 1.94 | 2.10 | | 2.0 | | 2.0 | |
| V _{T-} | Negative Threshold Voltage | | 3.0 | 0.35 | 0.76 | 0.93 | 0.35 | | 0.35 | | V |
| | | | 4.5 | 0.5 | 1.01 | 1.18 | 0.5 | | 0.5 | | |
| | | | 5.5 | 0.6 | 1.13 | 1.29 | 0.6 | | 0.6 | | |
| V _H | Hysteresis Voltage | | 3.0 | 0.30 | 0.64 | 1.20 | 0.30 | 1.20 | 0.30 | 1.20 | V |
| | | | 4.5 | 0.40 | 0.73 | 1.40 | 0.40 | 1.40 | 0.40 | 1.40 | |
| | | | 5.5 | 0.50 | 0.81 | 1.60 | 0.50 | 1.60 | 0.50 | 1.60 | |
| V _{OH} | Minimum High-Level Output Voltage | V _{IN} ≤ V _{T-MIN} I _{OH} = -50 μA | 2.0 | 1.9 | 2.0 | | 1.9 | | 1.9 | | V |
| | | | 3.0 | 2.9 | 3.0 | | 2.9 | | 2.9 | | |
| | | 4.5 | 4.4 | 4.5 | | 4.4 | | 4.4 | | | |
| | | V _{IN} ≤ V _{T-MIN} I _{OH} = -4 mA I _{OH} = -8 mA | 3.0 | 2.58 | | | 2.48 | | 2.34 | | |
| 4.5 | 3.94 | | | 3.80 | | 3.66 | | | | | |
| V _{OL} | Maximum Low-Level Output Voltage | V _{IN} ≥ V _{T+MAX} I _{OL} = 50 μA | 2.0 | | 0 | 0.1 | | 0.1 | | 0.1 | V |
| | | | 3.0 | | 0 | 0.1 | | 0.1 | | 0.1 | |
| | | 4.5 | | 0 | 0.1 | | 0.1 | | 0.1 | | |
| | | V _{IN} ≥ V _{T+MAX} I _{OL} = 4 mA I _{OL} = 8 mA | 3.0 | | | | | | | | |
| 4.5 | | | | 0.36 | | 0.44 | | 0.52 | | | |
| | | | | | 0.36 | | 0.44 | | 0.52 | | |
| I _{IN} | Input Leakage Current | 0 ≤ V _{IN} ≤ 5.5 V | 0 to 5.5 | | | | ±0.1 | | ±1.0 | μA | |
| I _{CC} | Quiescent Supply Current | 0 ≤ V _{IN} ≤ V _{CC} | 5.5 | | | 1.0 | | 20 | | 40 | μA |
| I _{CC(T)} | Quiescent Supply Current | V _{IN} = 3.4 V | 5.5 | | | 1.35 | | 1.50 | | 1.65 | mA |
| I _{OPD} | Output Leakage Current | V _{OUT} = 5.5 V | 0.0 | | | 0.5 | | 5.0 | | 10 | 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 to Output Y | 3.0 to 3.6 | C _L = 15 pF | | 7.0 | 12.8 | 1.0 | 15.0 | 1.0 | 17.0 | ns |
| | | | C _L = 50 pF | | 8.4 | 16.3 | 1.0 | 18.5 | 1.0 | 20.5 | |
| | | 4.5 to 5.5 | C _L = 15 pF | | 4.5 | 8.6 | 1.0 | 10.0 | 1.0 | 11.5 | |
| | | | C _L = 50 pF | | 5.8 | 10.6 | 1.0 | 12.0 | 1.0 | 13.5 | |
| C _{IN} | Input Capacitance | | | 5 | 10 | | 10 | | 10.0 | pF | |
| C _{PD} | Power Dissipation Capacitance (Note 6) | 5.0 | | 10.0 | | | | | | 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}.

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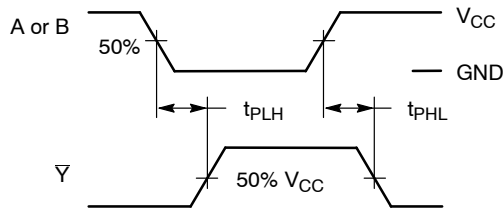
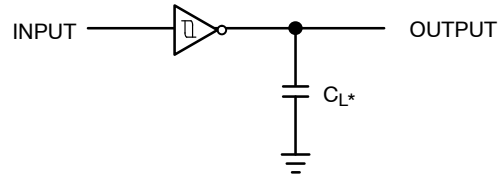
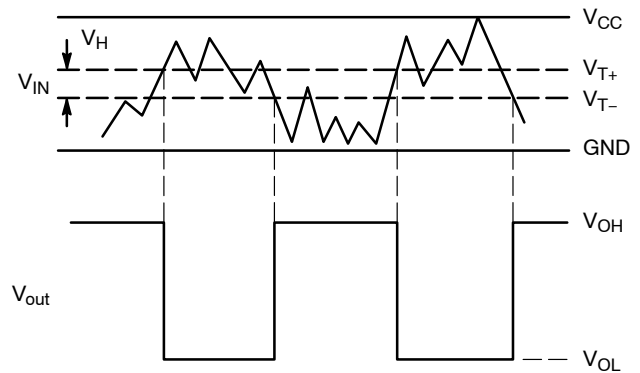
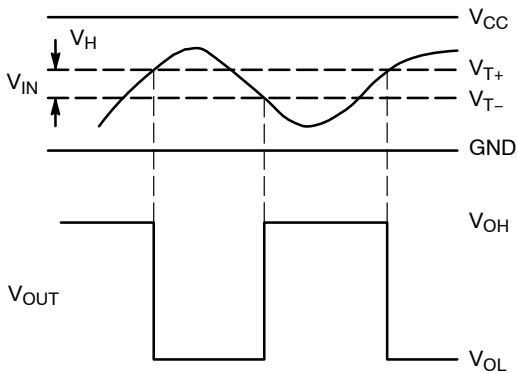


Figure 3. Switching Waveforms



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

Figure 4. Test Circuit



(a) A Schmitt-Trigger Squares Up Inputs With Slow Rise and Fall Times

(b) A Schmitt-Trigger Offers Maximum Noise Immunity

Figure 5. Typical Schmitt-Trigger Applications

ORDERING INFORMATION

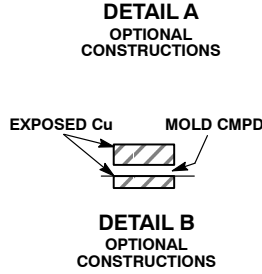
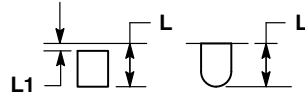
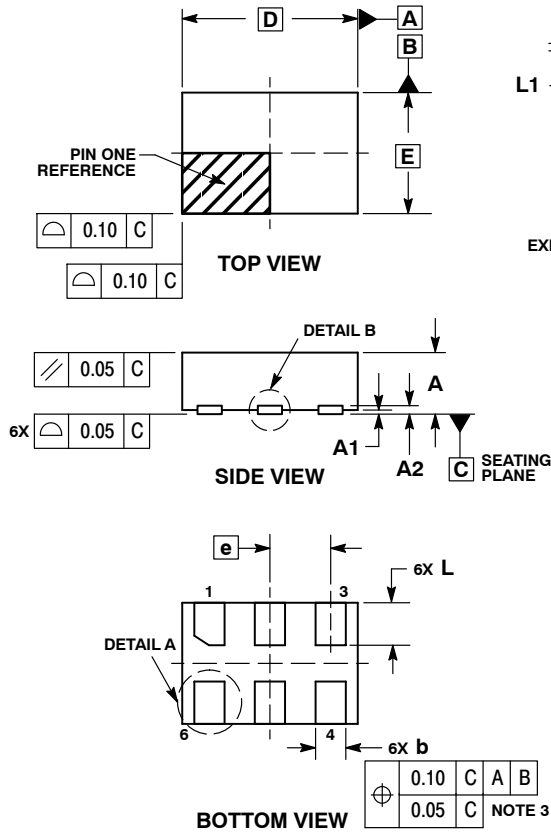
| Device | Package | Shipping† |
|-----------------|---------------------------------------|--------------------|
| NLU1GT14MUTCG | UDFN6, 1.2 x 1.0, 0.4P (Pb-Free) | 3000 / Tape & Reel |
| NLU1GT14AMX1TCG | ULLGA6, 1.45 x 1.0, 0.5P (Pb-Free) | 3000 / Tape & Reel |
| NLU1GT14BMX1TCG | ULLGA6, 1.2 x 1.0, 0.4P (Pb-Free) | 3000 / Tape & Reel |
| NLU1GT14CMX1TCG | ULLGA6, 1.0 x 1.0, 0.35P (Pb-Free) | 3000 / Tape & Reel |
| NLU1GT14AMUTCG | UDFN6, 1.45 x 1.0, 0.5P (Pb-Free) | 3000 / Tape & Reel |
| NLU1GT14CMUTCG | 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.

NLU1GT14

PACKAGE DIMENSIONS

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

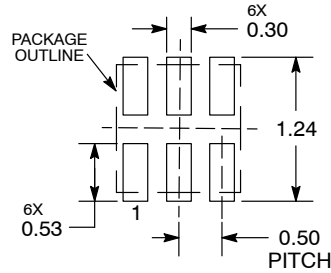


NOTES:

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



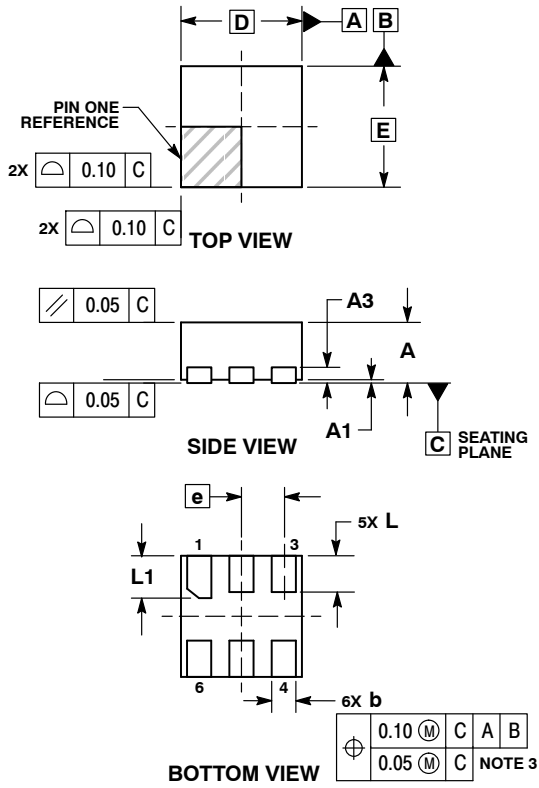
DIMENSIONS: MILLIMETERS

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

NLU1GT14

PACKAGE DIMENSIONS

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

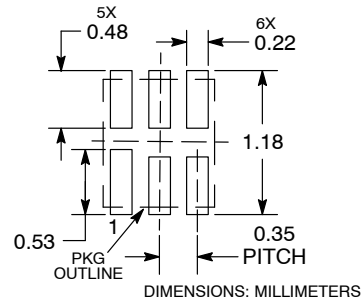


NOTES:

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*

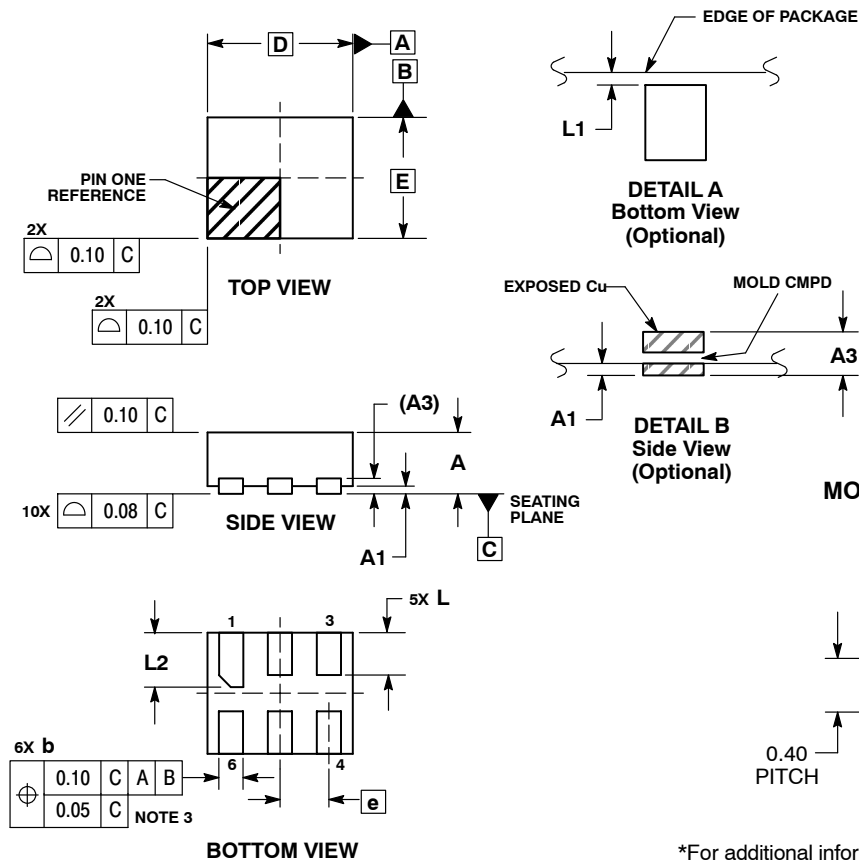


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NLU1GT14

PACKAGE DIMENSIONS

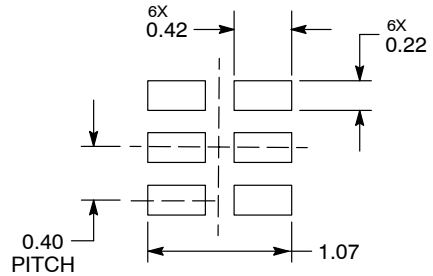
UDFN6, 1.2x1.0, 0.4P
CASE 517AA
ISSUE C



- 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*



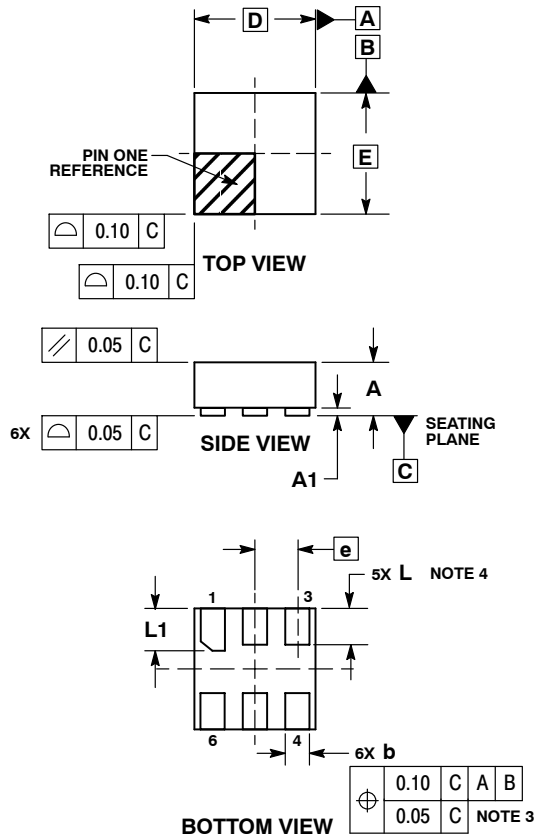
DIMENSIONS: MILLIMETERS

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NLU1GT14

PACKAGE DIMENSIONS

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

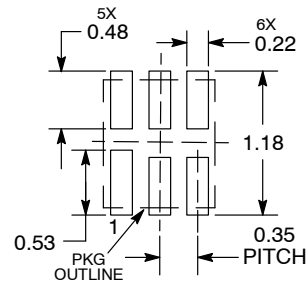


NOTES:

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*



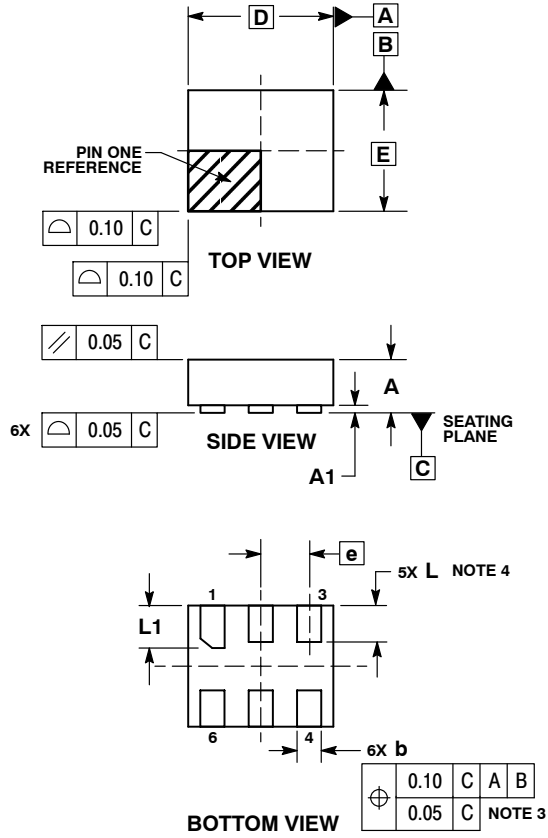
DIMENSIONS: MILLIMETERS

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NLU1GT14

PACKAGE DIMENSIONS

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

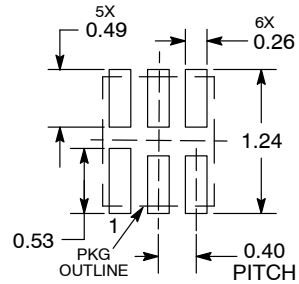


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1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
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4. A MAXIMUM OF 0.05 PULL BACK OF THE PLATED TERMINAL FROM THE EDGE OF THE PACKAGE IS ALLOWED.

| 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*



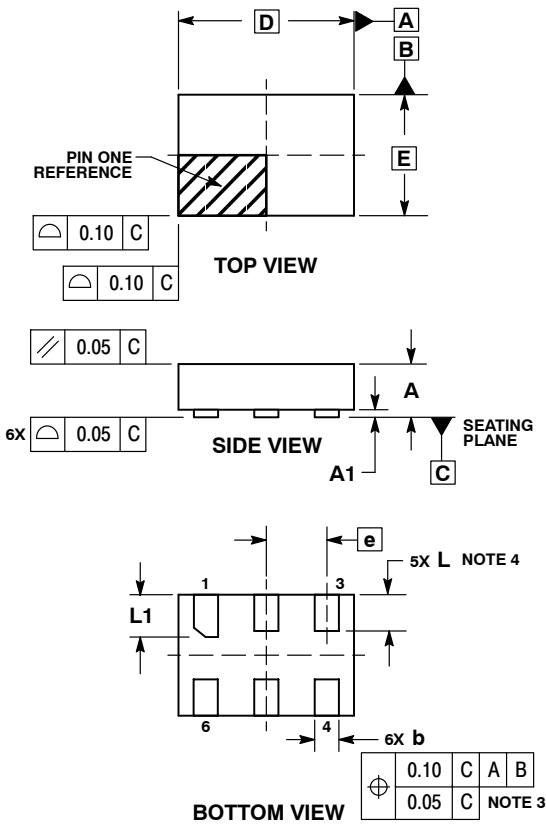
DIMENSIONS: MILLIMETERS

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NLU1GT14

PACKAGE DIMENSIONS

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

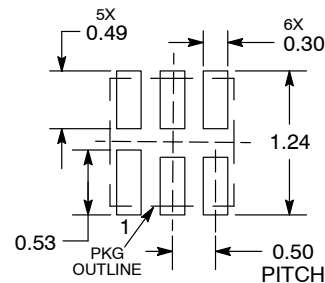


NOTES:

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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