# NLU2GU04

# Dual Unbuffered Inverter

The NLU2GU04 MiniGate™ is an advanced high−speed CMOS dual unbuffered inverter in ultra−small footprint.

This device is well suited for use in oscillator, pulse−shaping and high input impedance amplifier applications. For digital applications, the NLU2G04 is recommended.

The NLU2GU04 input and output structures provide protection when voltages up to 7 V are applied, regardless of the supply voltage.

## Features

- High Speed: $t_{PD}$ = 2.5 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
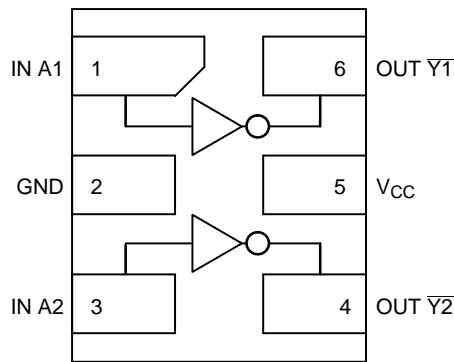- These are Pb−Free Devices



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



**Figure 2. Logic Symbol**

## PIN ASSIGNMENT

| 1 | IN A1 |
|---|---|
| 2 | GND |
| 3 | IN A2 |
| 4 | OUT $\overline{Y2}$ |
| 5 | $V_{CC}$ |
| 6 | OUT $\overline{Y1}$ |

## FUNCTION TABLE

| A | $\overline{Y}$ |
|---|---|
| L | H |
| H | L |

## ON Semiconductor®

### MARKING DIAGRAMS



| UDFN6 1.0 x 1.0 CASE 517BX | X M |
| UDFN6 MU SUFFIX CASE 517AA | Z M |
| UDFN6 1.45 x 1.0 CASE 517AQ | X M |
| ULLGA6 1.2 x 1.0 CASE 613AE | ZM |
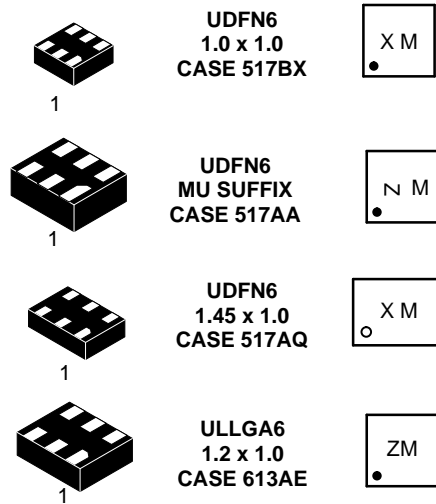
Z or 3 = Device Marking
M = Date Code

## ORDERING INFORMATION

# NLU2GU04

**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 | |
| $I_{LATCHUP}$ | Latchup Performance Above $V_{CC}$ and Below GND at 125°C (Note 2) | | ±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 / 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<br>$V_{CC}$ = 5.0 V ± 0.5 V | 0<br>0 | 100<br>20 | ns/V |

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## DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | $T_A$ = 25 °C Min | Typ | Max | $T_A$ = +85°C Min | Max | $T_A$ = −55°C to +125°C Min | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $V_{IH}$ | Low−Level Input Voltage | | 1.65<br><br>2.3 to 5.5 | 0.85 x $V_{CC}$<br>0.80 x $V_{CC}$ | | | 0.85 x $V_{CC}$<br>0.80 x $V_{CC}$ | | | | V |
| $V_{IL}$ | Low−Level Input Voltage | | 1.65<br><br>2.3 to 5.5 | | | 0.15 x $V_{CC}$<br>0.20 x $V_{CC}$ | | 0.15 x $V_{CC}$<br>0.20 x $V_{CC}$ | | 0.15 x $V_{CC}$<br>0.20 x $V_{CC}$ | V |
| $V_{OH}$ | 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 | $0 \leq V_{IN} \leq 5.5$ V | 0 to 5.5 | | | ±0.1 | | ±1.0 | | ±1.0 | µA |
| $I_{CC}$ | Quiescent Supply Current | $0 \leq V_{IN} \leq V_{CC}$ | 5.5 | | | 1.0 | | 20 | | 40 | µA |

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

| Symbol | Parameter | $V_{CC}$ (V) | Test Condition | $T_A$ = 25 °C Min | Typ | Max | $T_A$ = +85°C Min | Max | $T_A$ = −55°C to +125°C Min | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $t_{PLH}$, $t_{PHL}$ | Propagation Delay, Input A to Output $\overline{Y}$ | 3.0 to 3.6 | $C_L$ = 15 pF | | 3.5 | 8.9 | | 10.5 | | 12 | ns |
| | | | $C_L$ = 50 pF | | 4.8 | 11.4 | | 13 | | 15.5 | |
| | | 4.5 to 5.5 | $C_L$ = 15 pF | | 2.5 | 5.5 | | 6.5 | | 8.0 | |
| | | | $C_L$ = 50 pF | | 3.8 | 7.0 | | 8.0 | | 9.5 | |
| $C_{IN}$ | Input Capacitance | | | | 4 | 10 | | 10 | | 10 | pF |
| $C_{PD}$ | Power Dissipation Capacitance (Note 3) | 5.0 | | | 22 | | | | | | pF |

3. $C_{PD}$ 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: $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}$.
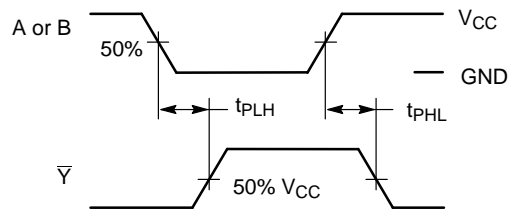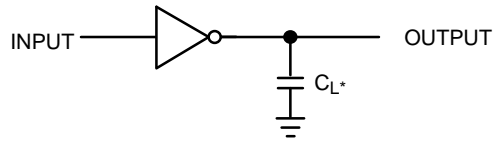
# NLU2GU04



**Figure 3. Switching Waveforms**



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

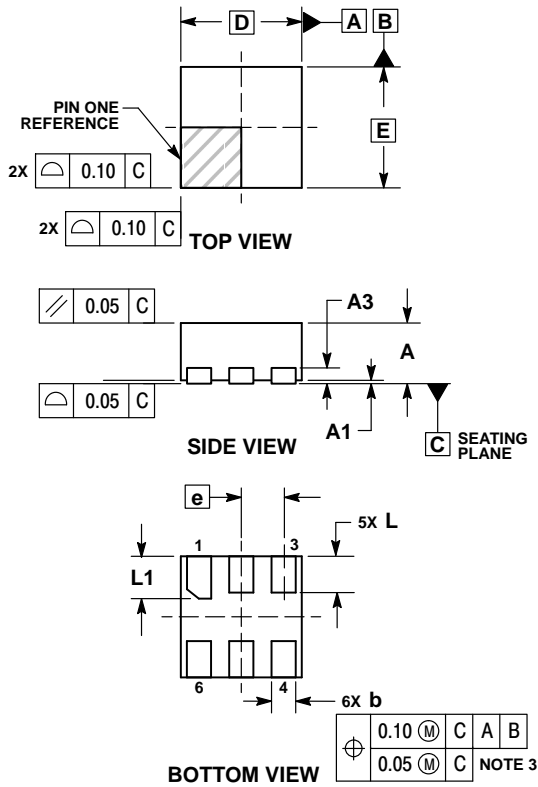**Figure 4. Test Circuit**

## ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| NLU2GU04MUTCG | UDFN6, 1.2 x 1.0, 0.4P (Pb−Free) | 3000 / Tape & Reel |
| NLU2GU04AMUTCG | UDFN6, 1.45 x 1.0, 0.5P (Pb−Free) | 3000 / Tape & Reel |
| NLU2GU04CMUTCG | UDFN6, 1.0 x 1.0, 0.35P (Pb−Free) | 3000 / Tape & Reel |
| NLU2GU04BMX1TCG | ULLGA6, 1.2 x 1.0, 0.4P (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 1.0x1.0, 0.35P**
CASE 517BX
ISSUE O

**TOP VIEW**

PIN ONE REFERENCE

2X | 0.10 | C

2X | 0.10 | C

**SIDE VIEW**

0.05 | C

A3

A

0.05 | C

A1

C SEATING PLANE

**BOTTOM VIEW**

e

5X L

L1

1    3
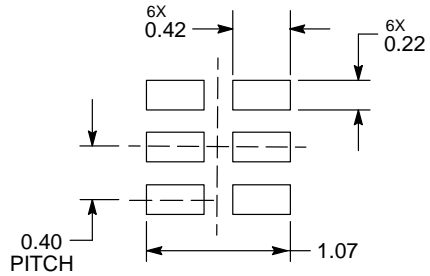
6    4

6X b

0.10 Ⓜ | C | A | B
0.05 Ⓜ | C | NOTE 3

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.

| DIM | MILLIMETERS | |
| --- | --- | --- |
| | 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*
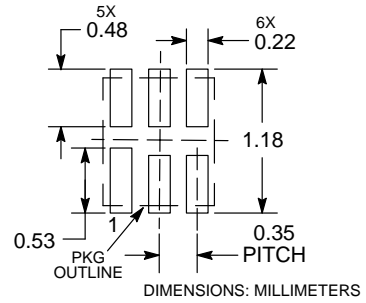
5X
0.48

6X
0.22

1.18

0.53

1

0.35
PITCH

PKG OUTLINE

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.
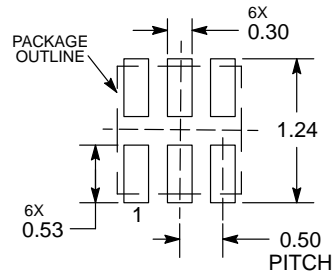
# NLU2GU04

## PACKAGE DIMENSIONS

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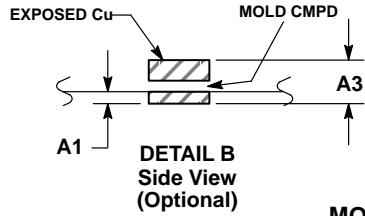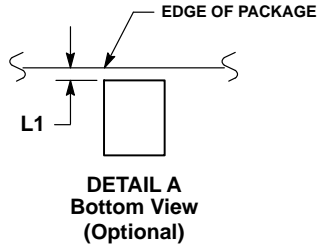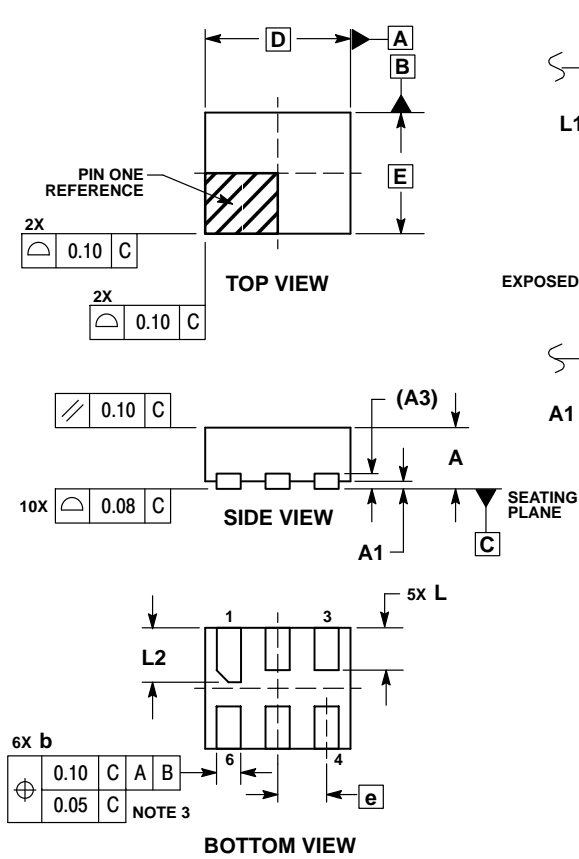
**TOP VIEW**

**PIN ONE REFERENCE**

2X | 0.10 | C

2X | 0.10 | C

**SIDE VIEW**

0.10 | C

10X | 0.08 | C

**SEATING PLANE**

C

**BOTTOM VIEW**

5X L

L2

6X b

| 0.10 | C | A | B
| 0.05 | C | **NOTE 3**

**EDGE OF PACKAGE**

L1

**DETAIL A
Bottom View
(Optional)**

**EXPOSED Cu**          **MOLD CMPD**

A3

A1

**DETAIL B
Side View
(Optional)**

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.

| DIM | MILLIMETERS | |
| | 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*

6X 0.42

6X 0.22

0.40 PITCH

1.07

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.

# NLU2GU04

## PACKAGE DIMENSIONS

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

**TOP VIEW**

**SIDE VIEW**

**BOTTOM VIEW**
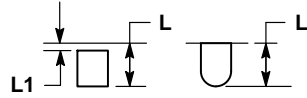
**DETAIL A**
OPTIONAL
CONSTRUCTIONS
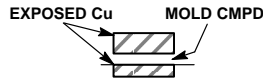
**DETAIL B**
OPTIONAL
CONSTRUCTIONS

EXPOSED Cu    MOLD CMPD

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.

| DIM | MILLIMETERS | |
|-----|-----|-----|
|     | 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

PACKAGE
OUTLINE

6X
0.30

1.24

6X
0.53

1

0.50
PITCH

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.

# NLU2GU04

## PACKAGE DIMENSIONS

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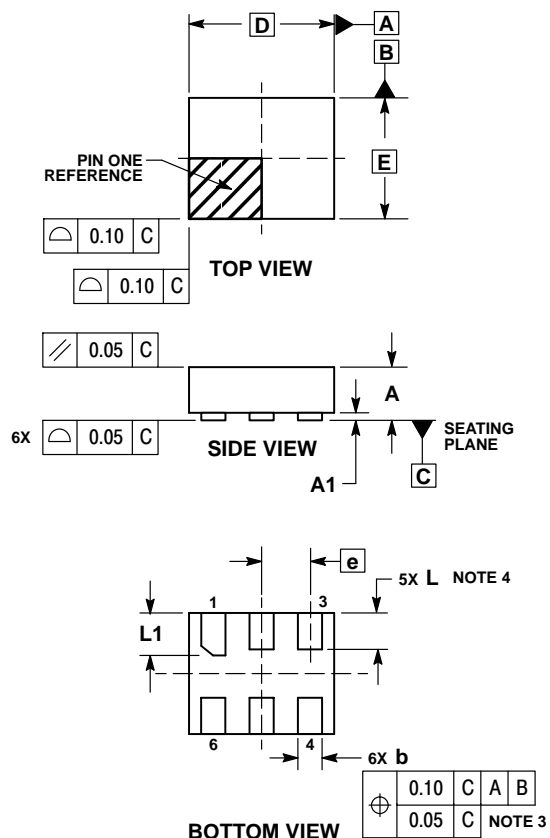


TOP VIEW

SIDE VIEW

BOTTOM VIEW

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.

| DIM | MILLIMETERS | |
| | 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*
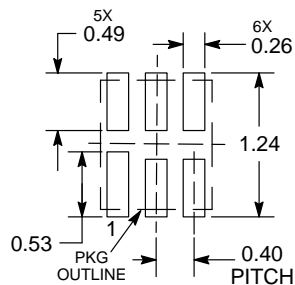


DIMENSIONS: MILLIMETERS

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

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**NLU2GU04/D**