

Unbuffered Inverter

NL17SGU04

The NL17SGU04 MiniGate™ is an advanced high-speed CMOS unbuffered inverter in ultra-small footprint.

The NL17SGU04 input structure provides protection when voltages up to 3.6 V are applied.

Features

- Wide Operating V_{CC} Range: 0.9 V to 3.6 V
- High Speed: $t_{PD} = 1.9$ ns (Typ) at $V_{CC} = 3.0$ V, $C_L = 15$ pF
- Low Power Dissipation: $I_{CC} = 0.5$ μ A (Max) at $T_A = 25^\circ$ C
- 3.6 V Overvoltage Tolerant (OVT) Input Pin
- Ultra-Small Packages
- -Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

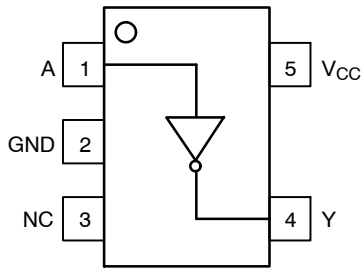


Figure 1. SOT-953
(Top Thru View)

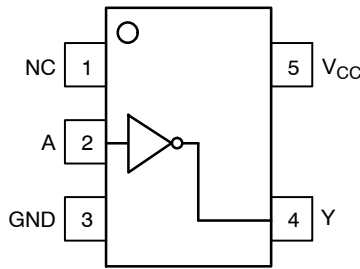


Figure 2. SC-88A
(Top View)

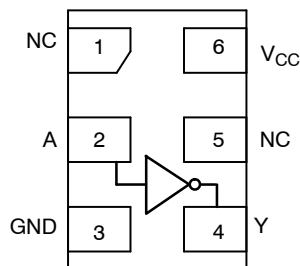


Figure 3. UDFN
(Top View)

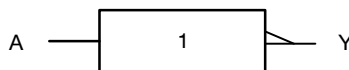
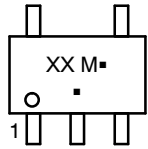


Figure 4. Logic Symbol

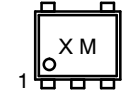
MARKING DIAGRAMS



SC-88A
DF SUFFIX
CASE 419A



SOT-953
P5 SUFFIX
CASE 527AE



UDFN6
1.45 x 1.0
CASE 517AQ



UDFN6
1.0 x 1.0
CASE 517BX



XX = Specific Device Code
M = Date Code*
▪ = Pb-Free Package

(Note: Microdot may be in either location)

*Date Code orientation and/or position may vary depending upon manufacturing location.

PIN ASSIGNMENT

| | SOT-953 | SC-88A | UDFN6 |
|---|----------|----------|----------|
| 1 | A | NC | NC |
| 2 | GND | A | A |
| 3 | NC | GND | GND |
| 4 | Y | Y | Y |
| 5 | V_{CC} | V_{CC} | NC |
| 6 | | | V_{CC} |

FUNCTION TABLE

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

ORDERING INFORMATION

See detailed ordering, marking and shipping information in the package dimensions section on page 6 of this data sheet.

NL17SGU04

Table 1. MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-----------------------|--|--|------------------------------------|
| V_{CC} | DC Supply Voltage | -0.5 to +4.3 | V |
| V_{IN} | DC Input Voltage | -0.5 to +4.3 | V |
| V_{OUT} | DC Output Voltage Active-Mode (High or Low State) Tri-State Mode (Note 1) Power-Down Mode ($V_{CC} = 0$ V) | -0.5 to $V_{CC} + 0.5$ -0.5 to +4.3 -0.5 to +4.3 | V |
| I_{IK} | DC Input Diode Current $V_{IN} < GND$ | -20 | mA |
| I_{OK} | DC Output Diode Current $V_{OUT} < GND$ | -20 | mA |
| I_{OUT} | DC Output Source/Sink Current | ± 20 | mA |
| I_{CC} or I_{GND} | DC Supply Current Per Supply Pin or Ground Pin | ± 20 | mA |
| T_{STG} | Storage Temperature Range | -65 to +150 | $^{\circ}C$ |
| T_L | Lead Temperature, 1 mm from Case for 10 Seconds | 260 | $^{\circ}C$ |
| T_J | Junction Temperature Under Bias | +150 | $^{\circ}C$ |
| θ_{JA} | Thermal Resistance (Note 2) | SC-88A SOT-953 UDFN6 | 377 254 154 $^{\circ}C/W$ |
| P_D | Power Dissipation in Still Air at 85 $^{\circ}C$ | SC-88A SOT-953 UDFN6 | 332 491 812 mW |
| 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 (Note 3) Human Body Model Charged Device Model | 2000 1000 | V |
| $I_{LATCHUP}$ | Latchup Performance (Note 4) | ± 100 | 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. Applicable to devices with outputs that may be tri-stated.
2. Measured with minimum pad spacing on an FR4 board, using 10 mm – by – 1inch, 2 ounce copper trace no air flow per JESD51-7.
3. HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.
4. Tested to EIA/JESD78 Class II.

Table 2. RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|------------|---|-------------|------------------------|-------------|
| V_{CC} | Positive DC Supply Voltage | 0.9 | 3.6 | V |
| V_{IN} | Digital Input Voltage | 0 | 3.6 | V |
| V_{OUT} | Output Voltage Active Mode (High or Low State) Tri-State Mode (Note 1) Power Down Mode ($V_{CC} = 0$ V) | 0 0 0 | V_{CC} 3.6 3.6 | V |
| T_A | Operating Free-Air Temperature | -55 | +125 | $^{\circ}C$ |
| t_r, t_f | Input Transition Rise or Fall Rate $V_{CC} = 3.3$ V \pm 0.3 V | 0 | 10 | nS/V |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

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DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Conditions | V _{CC} (V) | T _A = 25°C | | | T _A = -55°C to +125°C | | Unit |
|------------------|---------------------------|--|---------------------|------------------------|-----------------|------------------------|----------------------------------|------------------------|------|
| | | | | Min | Typ | Max | Min | Max | |
| V _{IH} | High-Level Input Voltage | | 0.9 | - | V _{CC} | - | - | - | V |
| | | | 1.1 to 1.3 | 0.8 x V _{CC} | - | - | 0.8 x V _{CC} | - | |
| | | | 1.4 to 1.6 | 0.8 x V _{CC} | - | - | 0.8 x V _{CC} | - | |
| | | | 1.65 to 1.95 | 0.8 x V _{CC} | - | - | 0.8 x V _{CC} | - | |
| | | | 2.3 to 2.7 | 0.8 x V _{CC} | - | - | 0.8 x V _{CC} | - | |
| | | | 3.0 to 3.6 | 0.8 x V _{CC} | - | - | 0.8 x V _{CC} | - | |
| V _{IL} | Low-Level Input Voltage | | 0.9 | - | GND | - | - | - | V |
| | | | 1.1 to 1.3 | - | - | 0.2 x V _{CC} | - | 0.2 x V _{CC} | |
| | | | 1.4 to 1.6 | - | - | 0.2 x V _{CC} | - | 0.2 x V _{CC} | |
| | | | 1.65 to 1.95 | - | - | 0.2 x V _{CC} | - | 0.2 x V _{CC} | |
| | | | 2.3 to 2.7 | - | - | 0.2 x V _{CC} | - | 0.2 x V _{CC} | |
| | | | 3.0 to 3.6 | - | - | 0.2 x V _{CC} | - | 0.2 x V _{CC} | |
| V _{OH} | High-Level Output Voltage | V _{IN} = V _{IH} or V _{IL} | | | | | | | V |
| | | I _{OH} = -20 μA | 0.9 | - | 0.75 | - | - | - | |
| | | I _{OH} = -0.3 mA | 1.1 to 1.3 | 0.75 x V _{CC} | - | - | 0.75 x V _{CC} | - | |
| | | I _{OH} = -1.7 mA | 1.4 to 1.6 | 0.75 x V _{CC} | - | - | 0.75 x V _{CC} | - | |
| | | I _{OH} = -3.0 mA | 1.65 to 1.95 | V _{CC} - 0.45 | - | - | V _{CC} - 0.45 | - | |
| | | I _{OH} = -4.0 mA | 2.3 to 2.7 | 2.0 | - | - | 2.0 | - | |
| V _{OL} | Low-Level Output Voltage | V _{IN} = V _{IH} or V _{IL} | | | | | | | V |
| | | I _{OL} = 20 μA | 0.9 | - | 0.1 | - | - | - | |
| | | I _{OL} = 0.3 mA | 1.1 to 1.3 | - | - | 0.25 x V _{CC} | - | 0.25 x V _{CC} | |
| | | I _{OL} = 1.7 mA | 1.4 to 1.6 | - | - | 0.25 x V _{CC} | - | 0.25 x V _{CC} | |
| | | I _{OL} = 3.0 mA | 1.65 to 1.95 | - | - | 0.45 | - | 0.45 | |
| | | I _{OL} = 4.0 mA | 2.3 to 2.7 | - | - | 0.4 | - | 0.4 | |
| I _{IN} | Input Leakage Current | V _{IN} = GND to 3.6 V | 0.9 to 3.6 | - | - | ±0.1 | - | ±1.0 | μA |
| | | | | | | | | | |
| I _{OFF} | Power Off Leakage Current | V _{IN} = 0 V to 3.6 V | 0 | - | - | 1.0 | - | 10.0 | μA |
| I _{CC} | Quiescent Supply Current | V _{IN} = V _{CC} or GND | 0.9 to 3.6 | - | - | 1.0 | - | 10.0 | 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.

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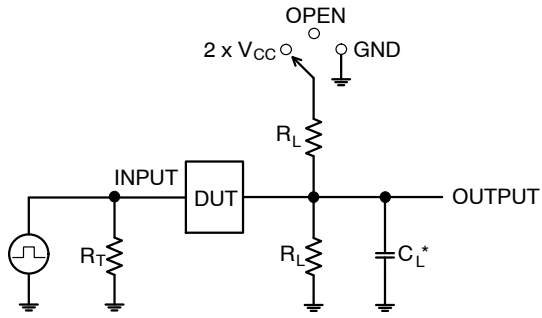
AC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test Condition | V _{CC} (V) | T _A = 25°C | | | T _A = -55°C to +125°C | | Unit | | |
|--|--|--|---------------------|-----------------------|------------|------|----------------------------------|------|------|-----|----|
| | | | | Min | Typ | Max | Min | Max | | | |
| t _{PLH} , t _{PHL} | Propagation Delay, A to Y | C _L = 10 pF, R _L = 1 MΩ | 0.9 | - | 12.7 | - | - | - | ns | | |
| | | | 1.1 to 1.3 | - | 6.0 | 9.2 | - | 12.2 | | | |
| | | | 1.4 to 1.6 | - | 3.2 | 8.5 | - | 10.0 | | | |
| | | | 1.65 to 1.95 | - | 2.6 | 6.2 | - | 6.7 | | | |
| | | | 2.3 to 2.7 | - | 2.0 | 3.9 | - | 4.4 | | | |
| | | | 3.0 to 3.6 | - | 1.7 | 3.1 | - | 3.7 | | | |
| | | C _L = 15 pF, R _L = 1 MΩ | 0.9 | - | 13.0 | - | - | - | ns | | |
| | | | 1.1 to 1.3 | - | 7.0 | 9.4 | - | 12.2 | | | |
| | | | 1.4 to 1.6 | - | 3.5 | 6.3 | - | 10.2 | | | |
| | | | 1.65 to 1.95 | - | 3.0 | 5.9 | - | 7.1 | | | |
| | | | 2.3 to 2.7 | - | 2.3 | 4.4 | - | 5.0 | | | |
| | | C _L = 30 pF, R _L = 1 MΩ | 0.9 | - | 14.1 | - | - | - | ns | | |
| | | | 1.1 to 1.3 | - | 9.0 | 11.6 | - | 13.8 | | | |
| | | | 1.4 to 1.6 | - | 6.0 | 9.1 | - | 12.9 | | | |
| | | | 1.65 to 1.95 | - | 4.5 | 8.2 | - | 9.6 | | | |
| | | | 2.3 to 2.7 | - | 3.2 | 5.7 | - | 6.1 | | | |
| | | | | | 3.0 to 3.6 | - | 2.5 | 4.4 | - | 4.8 | |
| | | C _{IN} | Input Capacitance | | 0 to 3.6 | | 3 | - | - | - | pF |
| C _O | Output Capacitance | V _O = GND | 0 | | 3 | - | - | - | pF | | |
| C _{PD} | Power Dissipation Capacitance (Note 5) | f = 10 MHz | 0.9 to 3.6 | - | 4 | - | - | - | pF | | |

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.

5. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the 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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C_L includes probe and jig capacitance
 R_T is Z_{OUT} of pulse generator (typically 50 Ω)
 $f = 1$ MHz

Figure 5. Test Circuit

| Test | Switch Position |
|---------------------|-------------------|
| t_{PLH} / t_{PHL} | Open |
| t_{PLZ} / t_{PZL} | $2 \times V_{CC}$ |
| t_{PHZ} / t_{PZH} | GND |

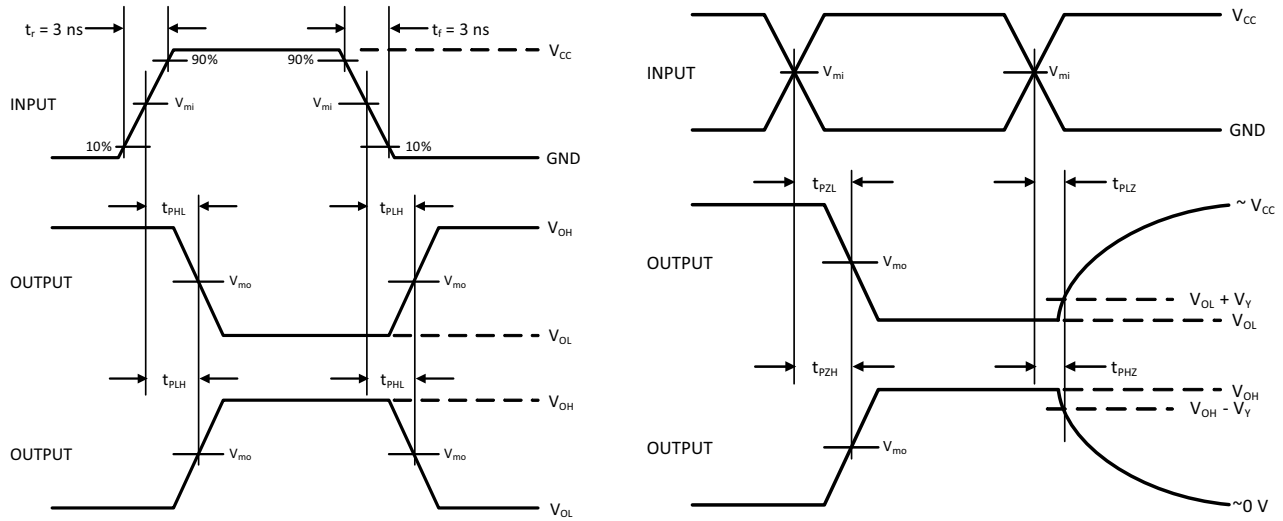


Figure 6. Switching Waveforms

| V_{CC}, V | V_{mi}, V | V_{mo}, V | V_Y, V |
|--------------|-------------|-------------|----------|
| 0.9 | $V_{CC}/2$ | $V_{CC}/2$ | 0.1 |
| 1.1 to 1.3 | $V_{CC}/2$ | $V_{CC}/2$ | 0.1 |
| 1.4 to 1.6 | $V_{CC}/2$ | $V_{CC}/2$ | 0.1 |
| 1.65 to 1.95 | $V_{CC}/2$ | $V_{CC}/2$ | 0.15 |
| 2.3 to 2.7 | $V_{CC}/2$ | $V_{CC}/2$ | 0.15 |
| 3.0 to 3.6 | 1.5 | 1.5 | 0.3 |

NL17SGU04

ORDERING INFORMATION

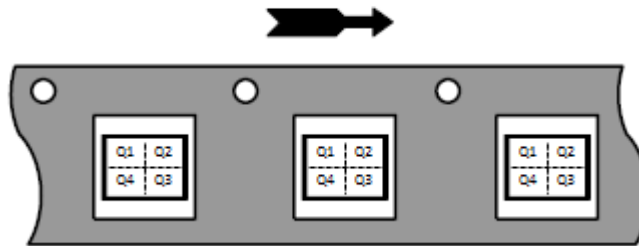
| Device | Package | Marking | Pin 1 Orientation (See below) | Shipping [†] |
|---|-------------------|---------------------|----------------------------------|-----------------------|
| NL17SGU04DFT2G | SC-88A | AY | Q4 | 3000 / Tape & Reel |
| NL17SGU04DFT2G-Q* | SC-88A | AY | Q4 | 3000 / Tape & Reel |
| NL17SGU04P5T5G | SOT-953 | 4 | Q2 | 8000 / Tape & Reel |
| NL17SGU04MU1TCG | UDFN6, 1.45 x 1.0 | 3 (Rotated 180° CW) | Q4 | 3000 / Tape & Reel |
| NL17SGU04MU3TCG (Contact onsemi) | UDFN6, 1.0 x 1.0 | TBD | Q4 | 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.

*-Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.

PIN 1 ORIENTATION IN TAPE AND REEL

Direction of Feed



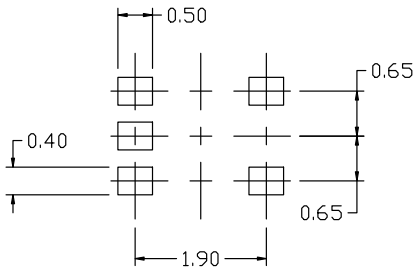
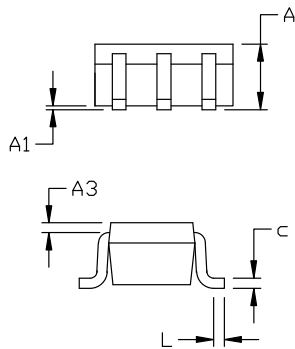
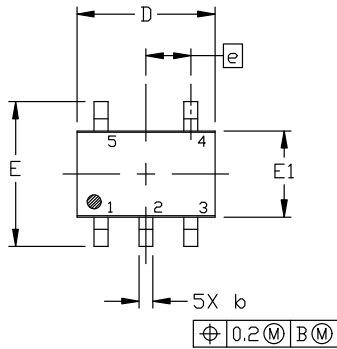
NL17SGU04

PACKAGE DIMENSIONS

SC-88A (SC-70-5/SOT-353)

CASE 419A-02

ISSUE M



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. 419A-01 OBSOLETE. NEW STANDARD 419A-02
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.1016MM PER SIDE.

| DIM | MILLIMETERS | | |
|-----|-------------|------|------|
| | MIN. | NOM. | MAX. |
| A | 0.80 | 0.95 | 1.10 |
| A1 | --- | --- | 0.10 |
| A3 | 0.20 REF | | |
| b | 0.10 | 0.20 | 0.30 |
| c | 0.10 | --- | 0.25 |
| D | 1.80 | 2.00 | 2.20 |
| E | 2.00 | 2.10 | 2.20 |
| E1 | 1.15 | 1.25 | 1.35 |
| e | 0.65 BSC | | |
| L | 0.10 | 0.15 | 0.30 |

RECOMMENDED MOUNTING FOOTPRINT

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

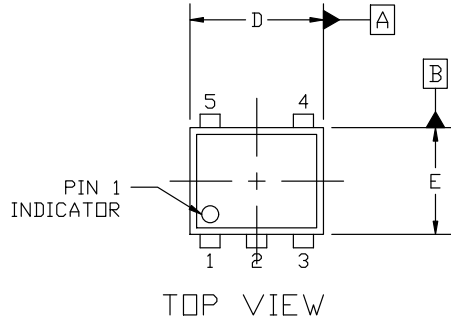
NL17SGU04

PACKAGE DIMENSIONS

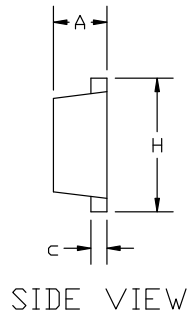
SOT-953 1.00x0.80x0.37, 0.35P
CASE 527AE
ISSUE F

NOTES:

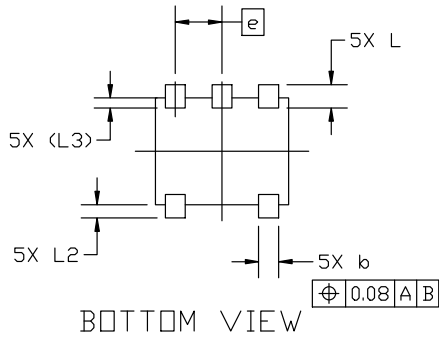
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.



TOP VIEW

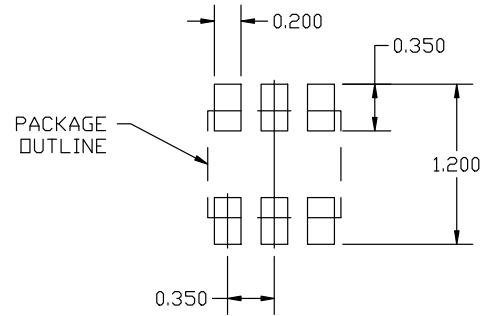


SIDE VIEW



BOTTOM VIEW

| MILLIMETERS | | | |
|-------------|-------------|-------|-------|
| DIM | MIN | NOM | MAX |
| A | 0.34 | 0.37 | 0.40 |
| b | 0.10 | 0.15 | 0.20 |
| C | 0.07 | 0.12 | 0.17 |
| D | 0.95 | 1.00 | 1.05 |
| E | 0.75 | 0.80 | 0.85 |
| e | 0.35 BSC | | |
| H | 0.95 | 1.00 | 1.05 |
| L | 0.125 | 0.175 | 0.225 |
| L2 | 0.05 | 0.10 | 0.15 |
| L3 | 0.075 (REF) | | |



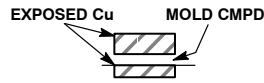
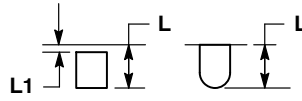
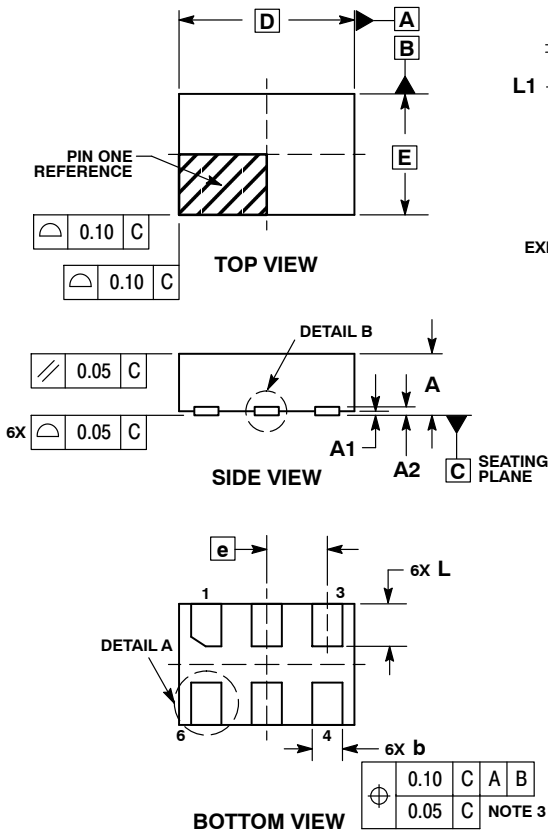
RECOMMENDED MOUNTING FOOTPRINT

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

NL17SGU04

PACKAGE DIMENSIONS

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

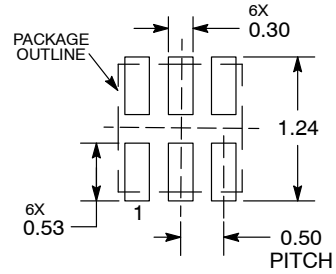


NOTES:

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



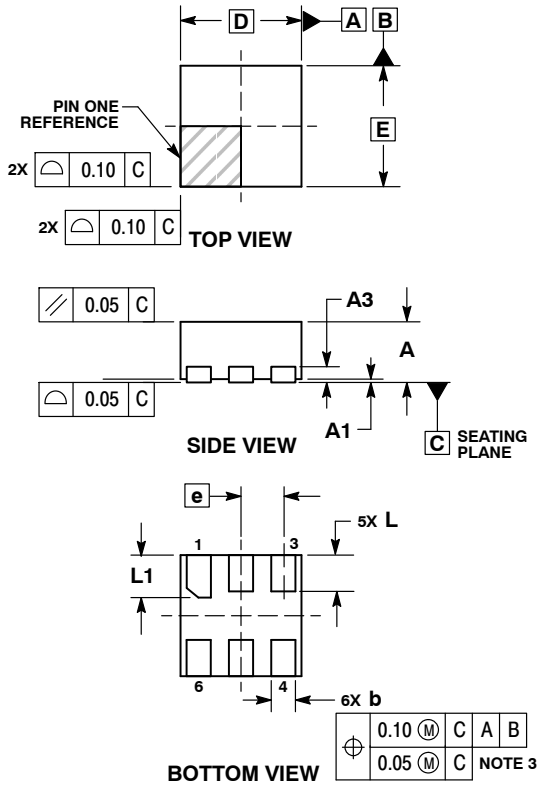
DIMENSIONS: MILLIMETERS

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

NL17SGU04

PACKAGE DIMENSIONS

UDFN6, 1x1, 0.35P
CASE 517BX
ISSUE O

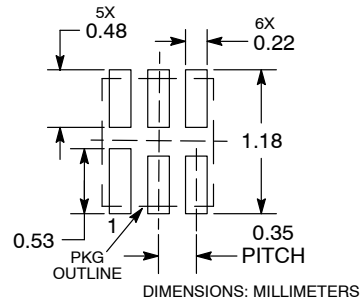


NOTES:

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.

| 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*



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

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