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Triple Inverter

NL37WZ04

The NL37WZ04 is a high performance triple inverter operating from a 1.65 V to 5.5 V supply.

Features

- Designed for 1.65 V to 5.5 V V_{CC} Operation
- 2.3 ns t_{PD} at $V_{CC} = 5$ V (Typ)
- Inputs/Outputs Overvoltage Tolerant up to 5.5 V
- I_{OFF} Supports Partial Power Down Protection
- Source/Sink 24 mA at 3.0 V
- Available in US8, UDFN8 and UQFN8 Packages
- Chip Complexity < 100 FETs
- NLV Prefix 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

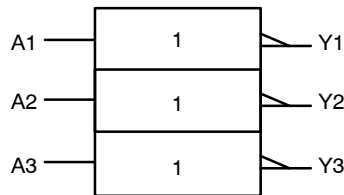

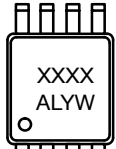

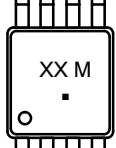

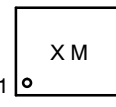

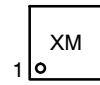

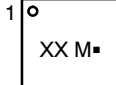


Figure 1. Logic Symbol



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| | | MARKING DIAGRAMS |
|---|--|---|
|  | US8 US SUFFIX CASE 493 |  Commercial |
|  | UDFN8, 1.45x1.0 MU3 SUFFIX CASE 517BZ |  NLV Prefix |
|  | UDFN8, 1.95x1.0 MU1 SUFFIX CASE 517CA |  |
|  | UQFN8, 1.4x1.2 MQ2 SUFFIX CASE 523AS |  |
|  | UQFN8, 1.6x1.6 MQ1 SUFFIX CASE 523AN |  |
| X, XX, XXXX = Specific Device Code A = Assembly Location L = Lot Code Y = Year Code W = Week Code M = Date Code ■ = Pb-Free Package | | |

ORDERING INFORMATION

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

NL37WZ04

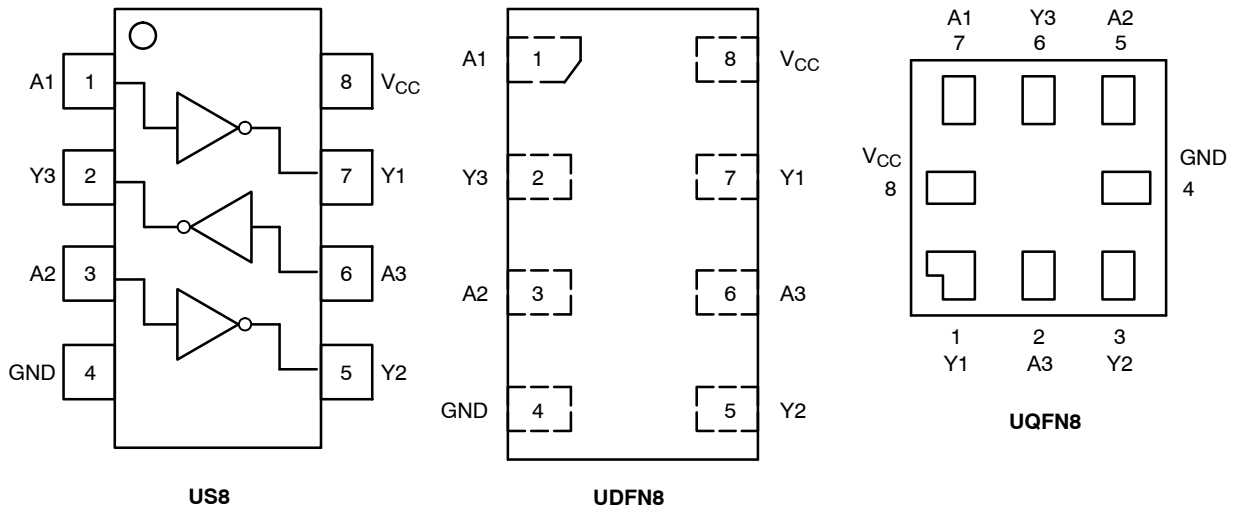


Figure 2. Pinout

PIN ASSIGNMENT

| Pin | US8 / UDFN8 | UQFN8 |
|-----|-----------------|-----------------|
| 1 | A1 | Y1 |
| 2 | Y3 | A3 |
| 3 | A2 | Y2 |
| 4 | GND | GND |
| 5 | Y2 | A2 |
| 6 | A3 | Y3 |
| 7 | Y1 | A1 |
| 8 | V _{CC} | V _{CC} |

FUNCTION TABLE

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

NL37WZ04

MAXIMUM RATINGS

| Symbol | Characteristics | Value | Unit |
|-------------------------------------|--|---|------|
| V _{CC} | DC Supply Voltage NLV | -0.5 to +7.0 -0.5 to +6.5 | V |
| V _{IN} | DC Input Voltage NLV | -0.5 to +7.0 -0.5 to +6.5 | V |
| V _{OUT} | DC Output Voltage (NLV) 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 +7.0 -0.5 to +7.0 | V |
| | 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 +6.5 -0.5 to +6.5 | V |
| I _{IK} | DC Input Diode Current V _{IN} < GND | -50 | mA |
| I _{OK} | DC Output Diode Current V _{OUT} < GND | -50 | mA |
| I _{OUT} | DC Output Source/Sink Current | ±50 | mA |
| I _{CC} or I _{GND} | DC Supply Current per Supply Pin or Ground Pin | ±100 | mA |
| T _{STG} | Storage Temperature Range | -65 to +150 | °C |
| T _L | Lead Temperature, 1 mm from Case for 10 secs | 260 | °C |
| T _J | Junction Temperature Under Bias | +150 | °C |
| θ _{JA} | Thermal Resistance (Note 2) | US8 UQFN8 UDFN8 250 210 231 | °C/W |
| P _D | Power Dissipation in Still Air | US8 UQFN8 UDFN8 500 595 541 | 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 10mm-by-1inch, 2 ounce copper trace no air flow per JESD51-7.
3. HBM tested to ANSI/ESDA/JEDEC JS-001-2017. CDM tested to EIA/JESD22-C101-F. JEDEC recommends that ESD qualification to EIA/JESD22-A115-A (Machine Model) be discontinued per JEDEC/JEP172A.
4. Tested to EIA/JESD78 Class II.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Characteristics | Min | Max | Unit |
|---------------------------------|--|------|-----------------|------|
| V _{CC} | Positive DC Supply Voltage | 1.65 | 5.5 | V |
| V _{IN} | DC Input Voltage | 0 | 5.5 | 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 | V _{CC} | |
| | | 0 | 5.5 | |
| | | 0 | 5.5 | |
| T _A | Operating Temperature Range | -55 | +125 | °C |
| t _r , t _f | Input Rise and Fall Time (NLV) V _{CC} = 3.0 V to 3.6 V V _{CC} = 4.5 V to 5.5 V | 0 | 100 | ns/V |
| | | 0 | 20 | |
| | Input Rise and Fall Time V _{CC} = 1.65 V to 1.95 V V _{CC} = 2.3 V to 2.7 V V _{CC} = 3.0 V to 3.6 V V _{CC} = 4.5 V to 5.5 V | 0 | 20 | |
| | | 0 | 10 | |
| | | 0 | 5 | |

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.

DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Condition | V _{CC} (V) | T _A = 25°C | | | -55°C ≤ T _A ≤ 125°C | | Units |
|------------------|---------------------------|---|---------------------|-----------------------|-----------------|----------------------|--------------------------------|----------------------|-------|
| | | | | Min | Typ | Max | Min | Max | |
| V _{IH} | High-Level Input Voltage | | 1.65 to 1.95 | 0.65 V _{CC} | - | - | 0.65 V _{CC} | - | V |
| | | | 2.3 to 5.5 | 0.70 V _{CC} | - | - | 0.70 V _{CC} | - | |
| V _{IL} | Low-Level Input Voltage | | 1.65 to 1.95 | - | - | 0.35 V _{CC} | - | 0.35 V _{CC} | V |
| | | | 2.3 to 5.5 | - | - | 0.30 V _{CC} | - | 0.30 V _{CC} | |
| V _{OH} | High-Level Output Voltage | V _{IN} = V _{IH} or V _{IL} I _{OH} = -100 μA I _{OH} = -4 mA I _{OH} = -8 mA I _{OH} = -12 mA I _{OH} = -16 mA I _{OH} = -24 mA I _{OH} = -32 mA | 1.65 to 5.5 | V _{CC} - 0.1 | V _{CC} | - | V _{CC} - 0.1 | - | V |
| | | | 1.65 | 1.29 | 1.4 | - | 1.29 | - | |
| | | | 2.3 | 1.9 | 2.1 | - | 1.9 | - | |
| | | | 2.7 | 2.2 | 2.4 | - | 2.2 | - | |
| | | | 3.0 | 2.4 | 2.7 | - | 2.4 | - | |
| | | | 3.0 | 2.3 | 2.5 | - | 2.3 | - | |
| | | | 4.5 | 3.8 | 4.0 | - | 3.8 | - | |
| V _{OL} | Low-Level Output Voltage | V _{IN} = V _{IH} or V _{IL} I _{OL} = 100 μA I _{OL} = 4 mA I _{OL} = 8 mA I _{OL} = 12 mA I _{OL} = 16 mA I _{OL} = 24 mA I _{OL} = 32 mA | 1.65 to 5.5 | - | - | 0.1 | - | 0.1 | V |
| | | | 1.65 | - | 0.08 | 0.24 | - | 0.24 | |
| | | | 2.3 | - | 0.2 | 0.3 | - | 0.3 | |
| | | | 2.7 | - | 0.22 | 0.4 | - | 0.4 | |
| | | | 3.0 | - | 0.28 | 0.4 | - | 0.4 | |
| | | | 3.0 | - | 0.38 | 0.55 | - | 0.55 | |
| | | | 4.5 | - | 0.42 | 0.55 | - | 0.55 | |
| I _{IN} | Input Leakage Current | V _{IN} = 5.5 V or GND | 1.65 to 5.5 | - | - | ±0.1 | - | ±1.0 | μA |
| I _{OFF} | Power Off Leakage Current | V _{IN} = 5.5 V or V _{OUT} = 5.5 V | 0 | - | - | 1.0 | - | 10 | μA |
| I _{CC} | Quiescent Supply Current | V _{IN} = V _{CC} or GND | 5.5 | - | - | 1.0 | - | 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

| Symbol | Parameter | V _{CC} (V) | Test Conditions | T _A = 25°C | | | T _A = -55 to 125°C | | Units |
|--|------------------------------|---------------------|--|--|-----|-----|-------------------------------|------|-------|
| | | | | Min | Typ | Max | Min | Max | |
| t _{PLH} , t _{PHL} | Propagation Delay, A to Y | 1.65 to 1.95 | C _L = 15 pF R _L = 1 MΩ R ₁ = Open | - | 4.4 | 9.5 | - | 10.0 | ns |
| | | 2.3 to 2.7 | | - | 5.0 | 5.7 | - | 6.1 | |
| | | 3.0 to 3.6 | | - | 2.2 | 3.4 | - | 3.8 | |
| | | 4.5 to 5.5 | | - | 1.8 | 2.8 | - | 3.1 | |
| | | 3.0 to 3.6 | | C _L = 50 pF, R _L = 500 Ω, R ₁ = Open | - | 3.9 | 4.5 | - | |
| | | 4.5 to 5.5 | - | | 2.3 | 3.6 | - | 4.0 | |

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}/2 (per flip-flop). 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}.

CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Condition | Typical | Units |
|------------------|---|---|---------|-------|
| C _{IN} | Input Capacitance | V _{CC} = 5.5 V, V _{IN} = 0 V or V _{CC} | 2.5 | pF |
| C _{OUT} | Output Capacitance | V _{CC} = 5.5 V, V _{IN} = 0 V or V _{CC} | 2.5 | pF |
| C _{PD} | Power Dissipation Capacitance (Note 6) | 10 MHz, V _{CC} = 3.3 V, V _{IN} = 0 V or V _{CC} | 9 | pF |
| | | 10 MHz, V _{CC} = 5.5 V, V _{IN} = 0 V or V _{CC} | 11 | |

6. 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}.

NL37WZ04



C_L includes probe and jig capacitance
 R_T is Z_{OUT} of pulse generator (typically 50 Ω)
 $f = 1$ MHz

Figure 3. Test Circuit

| Test | Switch Position | C_L , pF | R_L , Ω | R_1 , Ω |
|---------------------|-------------------|------------------------------|------------------|------------------|
| t_{PLH} / t_{PHL} | Open | See AC Characteristics Table | | |
| t_{PLZ} / t_{PZL} | $2 \times V_{CC}$ | 50 | 500 | 500 |
| t_{PHZ} / t_{PZH} | GND | 50 | 500 | 500 |

X = Don't Care



Figure 4. Switching Waveforms

| V_{CC} , V | V_{mi} , V | V_{mo} , V | | V_Y , V |
|--------------|--------------|-----------------------|---|-----------|
| | | t_{PLH} , t_{PHL} | t_{PZL} , t_{PLZ} , t_{PZH} , t_{PHZ} | |
| 1.65 to 1.95 | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | 0.15 |
| 2.3 to 2.7 | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | 0.15 |
| 3.0 to 3.6 | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | 0.3 |
| 4.5 to 5.5 | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | 0.3 |

NL37WZ04

DEVICE ORDERING INFORMATION

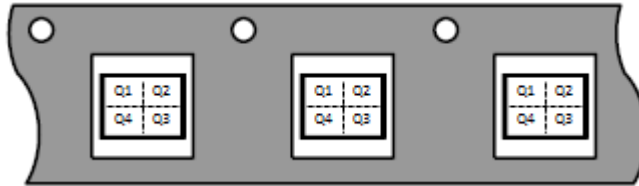
| Device | Packages | Specific Device Code | Pin 1 Orientation (See below) | Shipping† |
|------------------------------------|--------------------------|----------------------|----------------------------------|--------------------|
| NL37WZ04USG | US8 | L5 | Q4 | 3000 / Tape & Reel |
| NLV37WZ04USG* | US8 | L5 | Q4 | 3000 / Tape & Reel |
| NL37WZ04MQ1TCG (In Development) | UQFN8, 1.6 x 1.6, 0.5P | TBD | TBD | 3000 / Tape & Reel |
| NL37WZ04MU1TCG (In Development) | UDFN8, 1.95 x 1.0, 0.5P | TBD | TBD | 3000 / Tape & Reel |
| NL37WZ04MU3TCG (In Development) | UDFN8, 1.45 x 1.0, 0.35P | TBD | TBD | 3000 / Tape & Reel |
| NL37WZ04MQ2TCG (In Development) | UQFN8, 1.4 x 1.2, 0.4P | TBD | TBD | 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.

*NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

Pin 1 Orientation in Tape and Reel

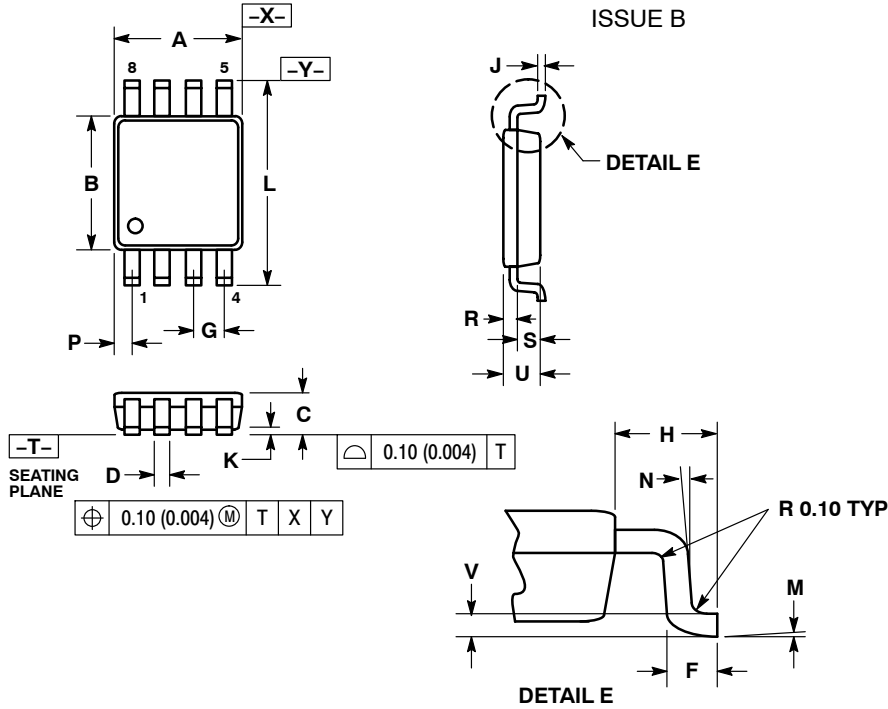
Direction of Feed



NL37WZ04

PACKAGE DIMENSIONS

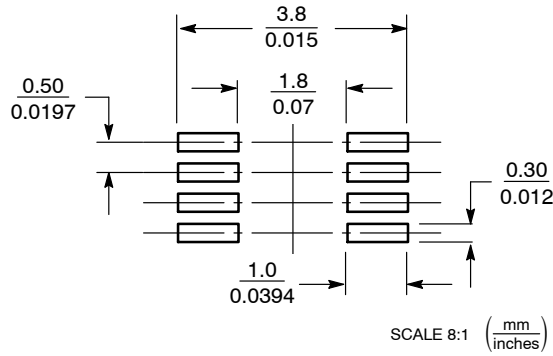
US8
US SUFFIX
CASE 493-02
ISSUE B



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETERS.
 3. DIMENSION "A" DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURR. MOLD FLASH, PROTRUSION AND GATE BURR SHALL NOT EXCEED 0.140 MM (0.0055") PER SIDE.
 4. DIMENSION "B" DOES NOT INCLUDE INTER-LEAD FLASH OR PROTRUSION. INTER-LEAD FLASH AND PROTRUSION SHALL NOT EXCEED 0.140 (0.0055") PER SIDE.
 5. LEAD FINISH IS SOLDER PLATING WITH THICKNESS OF 0.0076-0.0203 MM. (300-800 °).
 6. ALL TOLERANCE UNLESS OTHERWISE SPECIFIED ±0.0508 (0.0002").

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.90 | 2.10 | 0.075 | 0.083 |
| B | 2.20 | 2.40 | 0.087 | 0.094 |
| C | 0.60 | 0.90 | 0.024 | 0.035 |
| D | 0.17 | 0.25 | 0.007 | 0.010 |
| F | 0.20 | 0.35 | 0.008 | 0.014 |
| G | 0.50 BSC | | 0.020 BSC | |
| H | 0.40 REF | | 0.016 REF | |
| J | 0.10 | 0.18 | 0.004 | 0.007 |
| K | 0.00 | 0.10 | 0.000 | 0.004 |
| L | 3.00 | 3.20 | 0.118 | 0.126 |
| M | 0° | 6° | 0° | 6° |
| N | 5° | 10° | 5° | 10° |
| P | 0.23 | 0.34 | 0.010 | 0.013 |
| R | 0.23 | 0.33 | 0.009 | 0.013 |
| S | 0.37 | 0.47 | 0.015 | 0.019 |
| U | 0.60 | 0.80 | 0.024 | 0.031 |
| V | 0.12 BSC | | 0.005 BSC | |

SOLDERING FOOTPRINT*

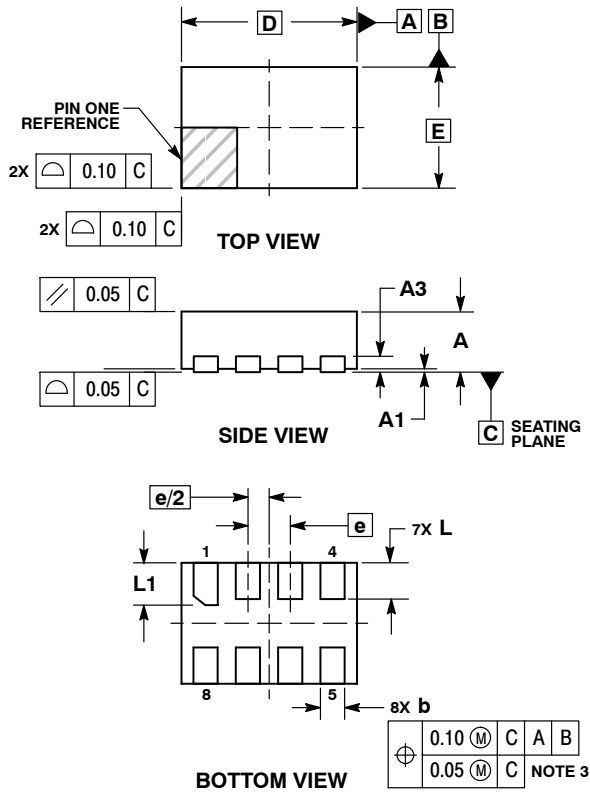


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NL37WZ04

PACKAGE DIMENSIONS

UDFN8, 1.45x1, 0.35P
CASE 517BZ
ISSUE O

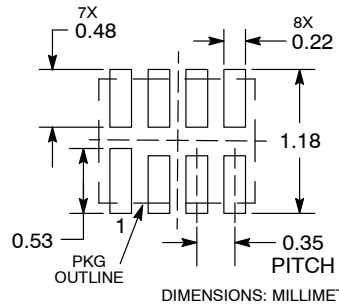


NOTES:

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 | 0.15 | 0.25 |
| D | 1.45 BSC | |
| E | 1.00 BSC | |
| e | 0.35 BSC | |
| L | 0.25 | 0.35 |
| L1 | 0.30 | 0.40 |

RECOMMENDED SOLDERING FOOTPRINT*

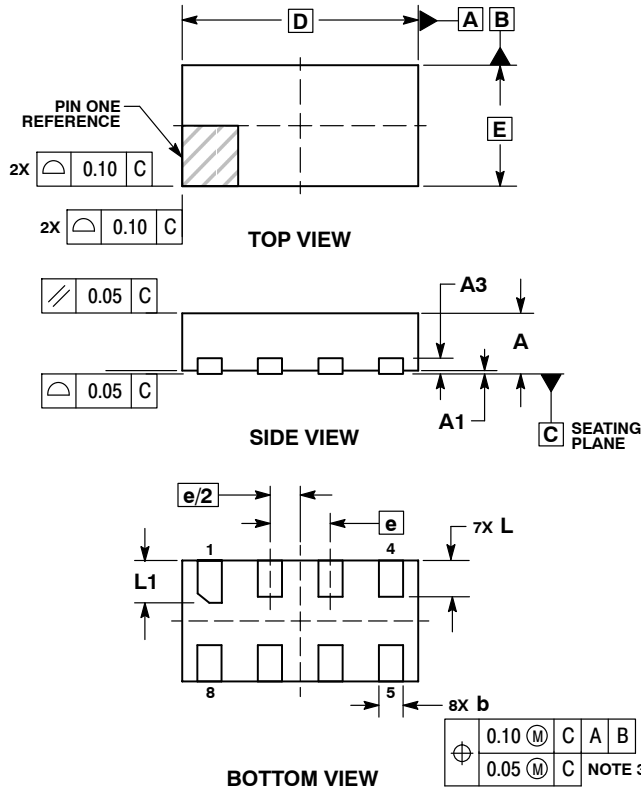


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NL37WZ04

PACKAGE DIMENSIONS

UDFN8, 1.95x1, 0.5P
CASE 517CA
ISSUE O

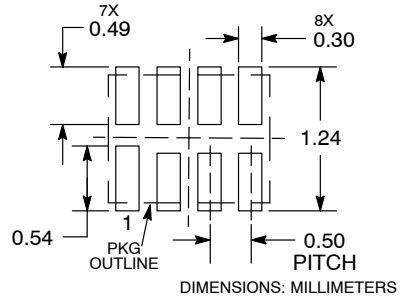


NOTES:

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 | 0.15 | 0.25 |
| D | 1.95 BSC | |
| E | 1.00 BSC | |
| e | 0.50 BSC | |
| L | 0.25 | 0.35 |
| L1 | 0.30 | 0.40 |

RECOMMENDED SOLDERING FOOTPRINT*

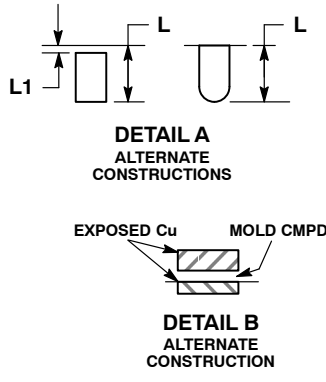
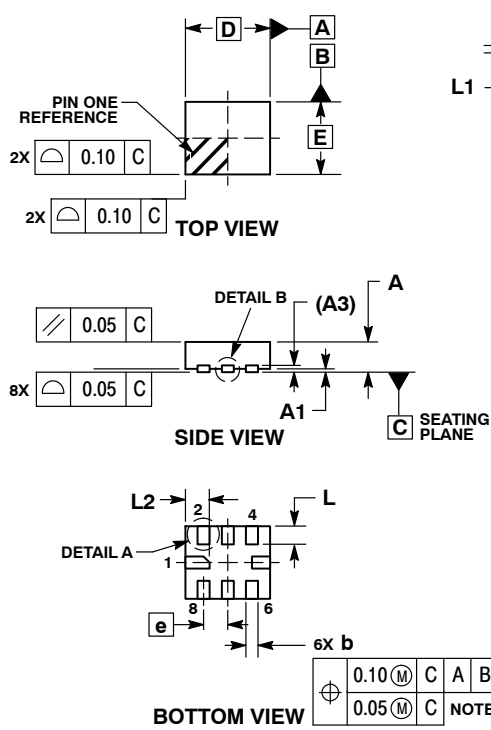


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NL37WZ04

PACKAGE DIMENSIONS

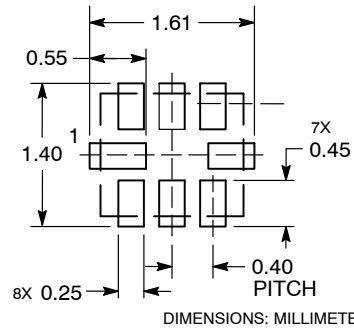
UQFN8, 1.4x1.2, 0.4P
CASE 523AS
ISSUE A



- 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 0.25 mm FROM THE TERMINAL TIP.

| MILLIMETERS | | |
|-------------|------|------|
| DIM | MIN | MAX |
| A | 0.45 | 0.55 |
| A1 | 0.00 | 0.05 |
| A3 | 0.13 | REF |
| b | 0.15 | 0.25 |
| D | 1.40 | BSC |
| E | 1.20 | BSC |
| e | 0.40 | BSC |
| L | 0.20 | 0.40 |
| L1 | --- | 0.15 |
| L2 | 0.30 | 0.50 |

SOLDERING FOOTPRINT*

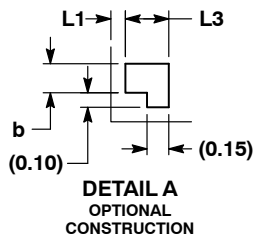
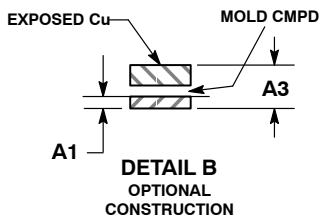
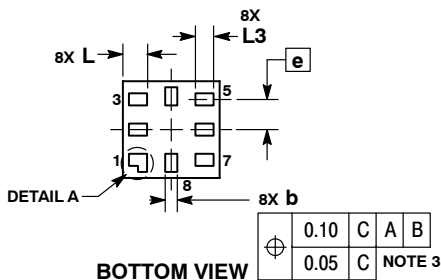
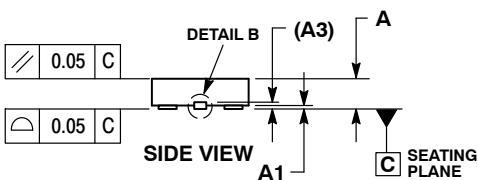
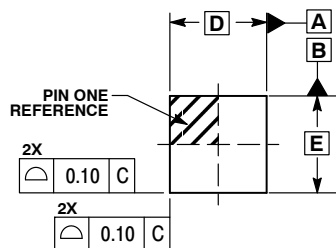


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NL37WZ04

PACKAGE DIMENSIONS

UQFN8, 1.6x1.6, 0.5P CASE 523AN ISSUE O

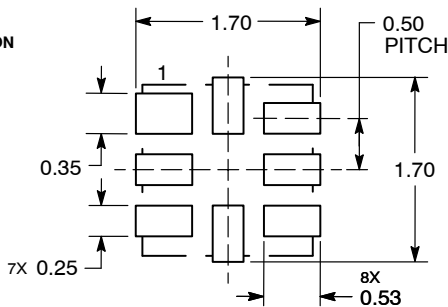


NOTES:

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 | 0.60 |
| A1 | 0.00 | 0.05 |
| A3 | 0.13 | REF |
| b | 0.15 | 0.25 |
| D | 1.60 | BSC |
| E | 1.60 | BSC |
| e | 0.50 | BSC |
| L | 0.35 | 0.45 |
| L1 | --- | 0.15 |
| L3 | 0.25 | 0.35 |

SOLDERING 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.

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