

# NL37WZ04

## Triple Inverter

The NL37WZ04 is a high performance triple inverter operating from a 1.65 V to 5.5 V supply. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance.

### Features

- Extremely High Speed:  $t_{PD}$  2.0 ns (typical) at  $V_{CC} = 5$  V
- Designed for 1.65 V to 5.5 V  $V_{CC}$  Operation
- Over Voltage Tolerant Inputs and Outputs
- LVTTTL Compatible – Interface Capability With 5 V TTL Logic with  $V_{CC} = 3$  V
- LVC MOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current Substantially Reduces System Power Requirements
- Chip Complexity: FET = 72
- 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 and are RoHS Compliant

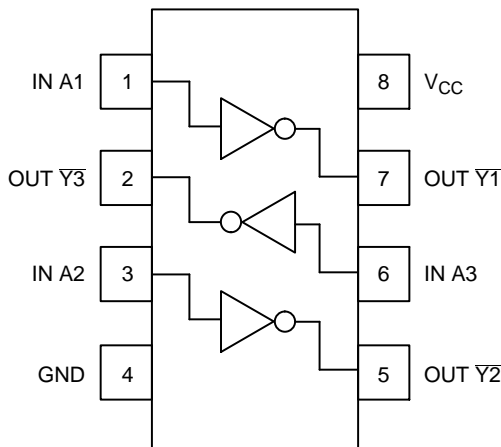


Figure 1. Pinout (Top View)

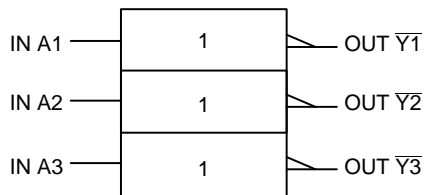


Figure 2. Logic Symbol



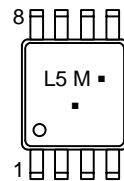
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US8  
US SUFFIX  
CASE 493

### MARKING DIAGRAM



L5 = Device Code  
M = Date Code\*  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation may vary depending upon manufacturing location.

### PIN ASSIGNMENT

| Pin | Function       |
|-----|----------------|
| 1   | IN A1          |
| 2   | OUT $\bar{Y}3$ |
| 3   | IN A2          |
| 4   | GND            |
| 5   | OUT $\bar{Y}2$ |
| 6   | IN A3          |
| 7   | OUT $\bar{Y}1$ |
| 8   | $V_{CC}$       |

### FUNCTION TABLE

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

### ORDERING INFORMATION

| Device       | Package       | Shipping†        |
|--------------|---------------|------------------|
| NL37WZ04USG  | US8 (Pb-Free) | 3000/Tape & Reel |
| NLV37WZ04USG | US8 (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.

# NL37WZ04

## MAXIMUM RATINGS

| Symbol           | Parameter   | Value                  | Units |
|------------------|---|------------------------|-------|
| V <sub>CC</sub>  | DC Supply Voltage   | -0.5 to +7.0           | V     |
| V <sub>I</sub>   | DC Input Voltage  | -0.5 to +7.0           | V     |
| V <sub>O</sub>   | DC Output Voltage   | -0.5 to +7.0           | V     |
| I <sub>IK</sub>  | DC Input Diode Current<br>V <sub>I</sub> < GND  | -50                    | mA    |
| I <sub>OK</sub>  | DC Output Diode Current<br>V <sub>O</sub> < GND   | -50                    | mA    |
| I <sub>O</sub>   | DC Output Sink Current  | ±50                    | mA    |
| I <sub>CC</sub>  | DC Supply Current per Supply Pin  | ±100                   | mA    |
| I <sub>GND</sub> | DC Ground Current per Ground Pin  | ±100                   | 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    |
| θ <sub>JA</sub>  | Thermal Resistance (Note 1)   | 250                    | °C/W  |
| P <sub>D</sub>   | Power Dissipation in Still Air at 85°C  | 250                    | mW    |
| MSL              | Moisture Sensitivity  | Level 1                |       |
| F <sub>R</sub>   | Flammability Rating<br>Oxygen Index: 28 to 34   | UL 94 V-0 @ 0.125 in   |       |
| V <sub>ESD</sub> | ESD Withstand Voltage<br>Human Body Model (Note 2)<br>Machine Model (Note 3)<br>Charged Device Model (Note 4) | > 2000<br>> 200<br>N/A | V     |

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 with no air flow.
2. Tested to EIA/JESD22-A114-A.
3. Tested to EIA/JESD22-A115-A.
4. Tested to JESD22-C101-A.

## RECOMMENDED OPERATING CONDITIONS

| Symbol          | Parameter  | Min         | Max           | Units |
|-----------------|--|-------------|---------------|-------|
| V <sub>CC</sub> | Supply Voltage<br>Operating<br>Data Retention Only   | 1.65<br>1.5 | 5.5<br>5.5    | V     |
| V <sub>I</sub>  | Input Voltage (Note 5)   | 0           | 5.5           | V     |
| V <sub>O</sub>  | Output Voltage (HIGH or LOW State)   | 0           | 5.5           | V     |
| T <sub>A</sub>  | Operating Free-Air Temperature   | -40         | +85           | °C    |
| Δt/ΔV           | Input Transition Rise or Fall Rate<br>V <sub>CC</sub> = 2.5 V ±0.2 V<br>V <sub>CC</sub> = 3.0 V ±0.3 V<br>V <sub>CC</sub> = 5.0 V ±0.5 V | 0<br>0<br>0 | 20<br>10<br>5 | ns/V  |

5. Unused inputs may not be left open. All inputs must be tied to a high- or low-logic input voltage level.

# NL37WZ04

## DC ELECTRICAL CHARACTERISTICS

| Symbol           | Parameter  | Condition   | V <sub>CC</sub> (V) | T <sub>A</sub> = 25°C |                 |                      | -40°C ≤ T <sub>A</sub> ≤ 85°C |                      | Units |
|------------------|--|---|---------------------|-----------------------|-----------------|----------------------|-------------------------------|----------------------|-------|
|                  |  |   |                     | Min                   | Typ             | Max                  | Min                           | Max                  |       |
| V <sub>IH</sub>  | High-Level Input Voltage                                       |   | 1.65                | 0.75 V <sub>CC</sub>  |                 |                      | 0.75 V <sub>CC</sub>          |                      | V     |
|                  |  |   | 2.3 to 5.5          | 0.7 V <sub>CC</sub>   |                 |                      | 0.7 V <sub>CC</sub>           |                      |       |
| V <sub>IL</sub>  | Low-Level Input Voltage  |   | 1.65                |                       |                 | 0.25 V <sub>CC</sub> |                               | 0.25 V <sub>CC</sub> | V     |
|                  |  |   | 2.3 to 5.5          |                       |                 | 0.3 V <sub>CC</sub>  |                               | 0.3 V <sub>CC</sub>  |       |
| V <sub>OH</sub>  | High-Level Output Voltage<br>V <sub>IN</sub> = V <sub>IL</sub> | I <sub>OH</sub> = -100 μA                           | 1.65 to 5.5         | V <sub>CC</sub> - 0.1 | V <sub>CC</sub> |                      | V <sub>CC</sub> - 0.1         |                      | V     |
|                  |  | I <sub>OH</sub> = -3 mA                             | 1.65                | 1.29                  | 1.52            |                      | 1.29                          |                      |       |
|                  |  | I <sub>OH</sub> = -8 mA                             | 2.3                 | 1.9                   | 2.1             |                      | 1.9                           |                      |       |
|                  |  | I <sub>OH</sub> = -12 mA                            | 2.7                 | 2.2                   | 2.4             |                      | 2.2                           |                      |       |
|                  |  | I <sub>OH</sub> = -16 mA                            | 3.0                 | 2.4                   | 2.7             |                      | 2.4                           |                      |       |
|                  |  | I <sub>OH</sub> = -24 mA                            | 3.0                 | 2.3                   | 2.5             |                      | 2.3                           |                      |       |
|                  |  | I <sub>OH</sub> = -32 mA                            | 4.5                 | 3.8                   | 4.0             |                      | 3.8                           |                      |       |
| V <sub>OL</sub>  | Low-Level Output Voltage<br>V <sub>IN</sub> = V <sub>IH</sub>  | I <sub>OL</sub> = 100 μA                            | 1.65 to 5.5         |                       |                 | 0.1                  |                               | 0.1                  | V     |
|                  |  | I <sub>OL</sub> = 3 mA                              | 1.65                |                       | 0.08            | 0.24                 |                               | 0.24                 |       |
|                  |  | I <sub>OL</sub> = 8 mA                              | 2.3                 |                       | 0.20            | 0.3                  |                               | 0.3                  |       |
|                  |  | I <sub>OL</sub> = 12 mA                             | 2.7                 |                       | 0.22            | 0.4                  |                               | 0.4                  |       |
|                  |  | I <sub>OL</sub> = 16 mA                             | 3.0                 |                       | 0.28            | 0.4                  |                               | 0.4                  |       |
|                  |  | I <sub>OL</sub> = 24 mA                             | 3.0                 |                       | 0.38            | 0.55                 |                               | 0.55                 |       |
|                  |  | I <sub>OL</sub> = 32 mA                             | 4.5                 |                       | 0.42            | 0.55                 |                               | 0.55                 |       |
| I <sub>IN</sub>  | Input Leakage Current  | V <sub>IN</sub> = 5.5 V or GND                      | 0 to 5.5            |                       |                 | ±0.1                 |                               | ±1.0                 | μA    |
| I <sub>OFF</sub> | Power Off Leakage Current                                      | V <sub>IN</sub> = 5.5 V or V <sub>OUT</sub> = 5.5 V | 0                   |                       |                 | 1                    |                               | 10                   | μA    |
| I <sub>CC</sub>  | Quiescent Supply Current                                       | V <sub>IN</sub> = 5.5 V or GND                      | 5.5                 |                       |                 | 1                    |                               | 10                   | μA    |

## AC ELECTRICAL CHARACTERISTICS t<sub>R</sub> = t<sub>F</sub> = 2.5 ns; C<sub>L</sub> = 50 pF; R<sub>L</sub> = 500 Ω

| Symbol                               | Parameter                             | Condition   | V <sub>CC</sub> (V) | T <sub>A</sub> = 25°C |            |            | -40°C ≤ T <sub>A</sub> ≤ 85°C |            | Units |
|--------------------------------------|---------------------------------------|---|---------------------|-----------------------|------------|------------|-------------------------------|------------|-------|
|                                      |                                       |   |                     | Min                   | Typ        | Max        | Min                           | Max        |       |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay<br>(Figure 3 and 4) | R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF   | 1.8 ± 0.15          | 1.8                   | 4.4        | 9.5        | 2.0                           | 10         | ns    |
|                                      |                                       | R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF   | 2.5 ± 0.2           | 1.2                   | 5.0        | 5.7        | 1.2                           | 6.1        |       |
|                                      |                                       | R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF<br>R <sub>L</sub> = 500 Ω, C <sub>L</sub> = 50 pF | 3.3 ± 0.3           | 0.8<br>1.2            | 2.2<br>3.9 | 3.4<br>4.5 | 0.8<br>1.2                    | 3.8<br>5.0 |       |
|                                      |                                       | R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF<br>R <sub>L</sub> = 500 Ω, C <sub>L</sub> = 50 pF | 5.0 ± 0.5           | 0.5<br>0.8            | 1.8<br>2.3 | 2.8<br>3.6 | 0.5<br>0.8                    | 3.1<br>4.0 |       |

## CAPACITIVE CHARACTERISTICS

| Symbol          | Parameter                              | Condition  | Typical | Units |
|-----------------|--|--|---------|-------|
| C <sub>IN</sub> | Input Capacitance                      | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0 V or V <sub>CC</sub>   | 2.5     | pF    |
| C <sub>PD</sub> | Power Dissipation Capacitance (Note 6) | 10 MHz, V <sub>CC</sub> = 3.3 V, V <sub>I</sub> = 0 V or V <sub>CC</sub><br>10 MHz, V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0 V or V <sub>CC</sub> | 9<br>11 | pF    |

6. C<sub>PD</sub> 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<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>.

# NL37WZ04

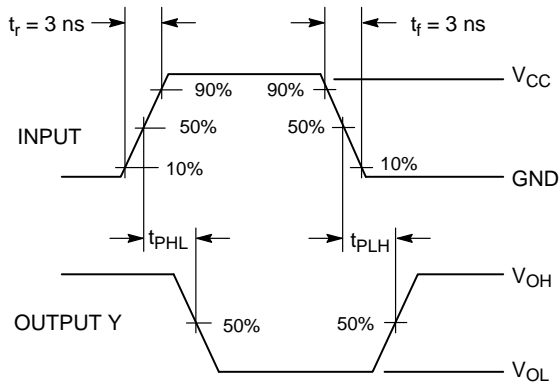
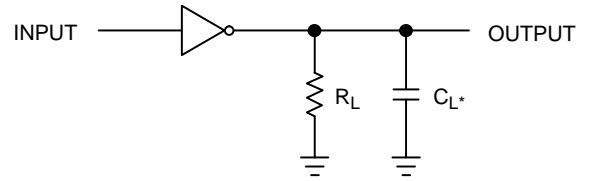


Figure 3. Switching Waveform



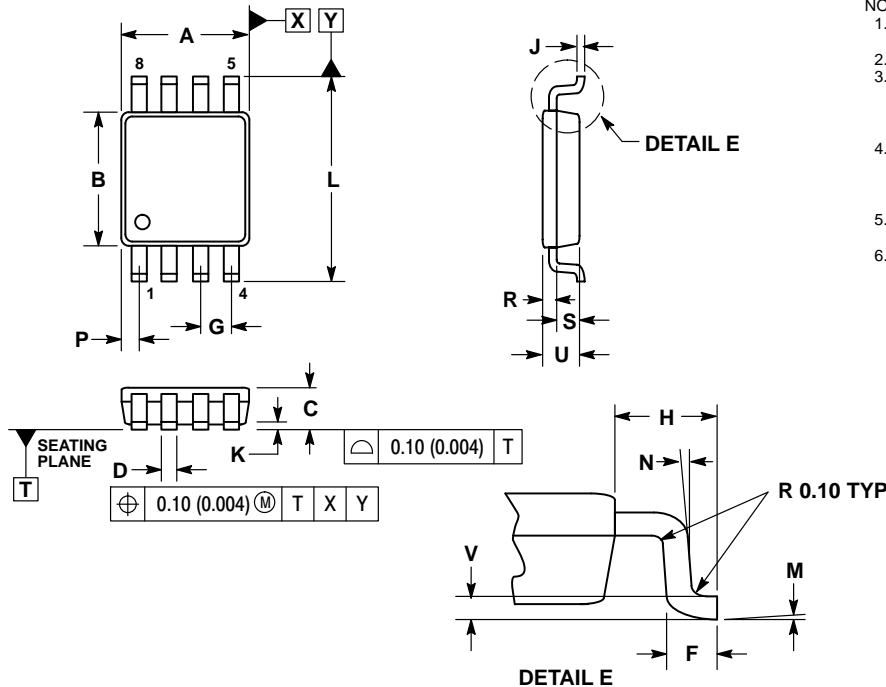
\* $C_L$  includes all probe and jig capacitances.  
A 1-MHz square input wave is recommended for propagation delay tests.

Figure 4. Test Circuit

# NL37WZ04

## PACKAGE DIMENSIONS

US8  
CASE 493-02  
ISSUE C

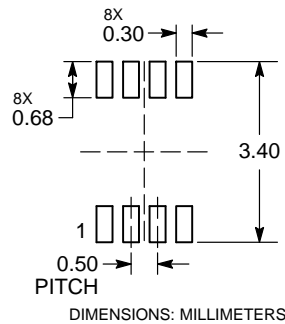


**NOTES:**

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 0.14MM (0.0055") PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH AND PROTRUSION SHALL NOT EXCEED 0.14MM (0.0055") PER SIDE.
5. LEAD FINISH IS SOLDER PLATING WITH THICKNESS OF 0.0076-0.0203MM (0.003-0.008").
6. ALL TOLERANCE UNLESS OTHERWISE SPECIFIED  $\pm 0.0508\text{MM}$  (0.002").

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 1.80        | 2.10 | 0.075     | 0.083 |
| B   | 2.20        | 2.40 | 0.087     | 0.094 |
| C   | 0.60        | 0.80 | 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     | 0.128 |
| M   | 0°          | 6°   | 0°        | 6°    |
| N   | 0°          | 10°  | 0°        | 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 |       |

### 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.

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