

# NL17SZ04

## Single Inverter

The NL17SZ04 is an inverter in two tiny footprint packages. The device performs much as LCX multi-gate products in speed and drive.

### Features

- Tiny SOT-353 and SOT-553 Packages
- 24 mA Sink and Source Output Capability
- Over-Voltage Tolerant Inputs and Outputs
- Pin For Pin with NC7SZ04P5X, TC7SZ04FU and TC7SZ04AFE
- Chip Complexity: FETs = 20
- Designed for 1.65 V to 5.5 V  $V_{CC}$  Operation
- Pb-Free Packages are Available

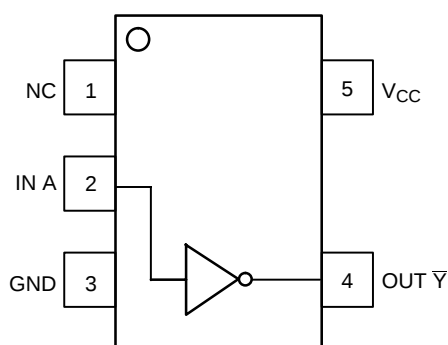


Figure 1. Pinout (Top View)

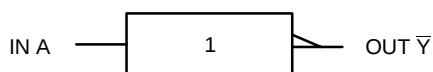
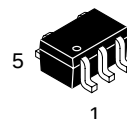


Figure 2. Logic Symbol



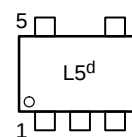
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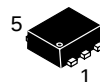


**SOT-353/SC70-5/SC-88A**  
**DF SUFFIX**  
**CASE 419A**

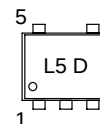
### MARKING DIAGRAMS



d = Date Code



**SOT-553**  
**XV5 SUFFIX**  
**CASE 463B**



L5 = Device Marking  
D = One Digit Date Code

### PIN ASSIGNMENT

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

### FUNCTION TABLE

| A Input | $\bar{Y}$ Output |
|---------|------------------|
| L       | H                |
| H       | L                |

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

# NL17SZ04

## MAXIMUM RATINGS

| Symbol           | Parameter                                                                                                  | Value                         | Unit |
|------------------|------------------------------------------------------------------------------------------------------------|-------------------------------|------|
| V <sub>CC</sub>  | DC Supply Voltage                                                                                          | − 0.5 to +7.0                 | V    |
| V <sub>I</sub>   | DC Input Voltage                                                                                           | − 0.5 ≤ V <sub>I</sub> ≤ +7.0 | V    |
| V <sub>O</sub>   | DC Output Voltage<br>Output in Higher or Low State (Note 1)                                                | − 0.5 ≤ V <sub>O</sub> ≤ +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 Supply 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<br>SOT-353 (Note 2)<br>SOT-553                                                          | 350<br>496                    | °C/W |
| P <sub>D</sub>   | Power Dissipation in Still Air at 85°C<br>SOT-353<br>SOT-553                                               | 186<br>135                    | 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          |      |
| ESD              | ESD Classification<br>Human Body Model (Note 3)<br>Machine Model (Note 4)<br>Charged Device Model (Note 5) | Class IC<br>Class A<br>N/A    |      |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. IO absolute maximum rating must be observed.
2. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2-ounce copper trace with no air flow.
3. Tested to EIA/JESD22-A114-A, rated to EIA/JESD22-A114-B.
4. Tested to EIA/JESD22-A115-A, rated to EIA/JESD22-A115-A.
5. Tested to JESD22-C101-A.

## RECOMMENDED OPERATING CONDITIONS

| Symbol                          | Parameter                                                                                                                         | Min         | Max           | Unit |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------|---------------|------|
| V <sub>CC</sub>                 | DC Supply Voltage<br>Operating<br>Data Retention                                                                                  | 1.65<br>1.5 | 5.5<br>5.5    | V    |
| V <sub>IN</sub>                 | DC Input Voltage                                                                                                                  | 0           | 5.5           | V    |
| V <sub>OUT</sub>                | DC Output Voltage<br>(High or Low State)                                                                                          | 0           | 5.5           | V    |
| T <sub>A</sub>                  | Operating Temperature Range                                                                                                       | −40         | +85           | °C   |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise and Fall Time<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 |

# 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               |                                             | Unit |
|------------------|----------------------------------------------------------------|--------------------------------------------------------|----------------------------|---------------------------------------------|-----------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|------|
|                  |                                                                |                                                        |                            | Min                                         | Typ             | Max                                         | Min                                         | Max                                         |      |
| V <sub>IH</sub>  | High-Level Input Voltage                                       |                                                        | 1.65 to 1.95<br>2.3 to 5.5 | 0.75 V <sub>CC</sub><br>0.7 V <sub>CC</sub> |                 |                                             | 0.75 V <sub>CC</sub><br>0.7 V <sub>CC</sub> |                                             | V    |
| V <sub>IL</sub>  | Low-Level Input Voltage                                        |                                                        | 1.65 to 1.95<br>2.3 to 5.5 |                                             |                 | 0.25 V <sub>CC</sub><br>0.3 V <sub>CC</sub> |                                             | 0.25 V <sub>CC</sub><br>0.3 V <sub>CC</sub> | V    |
| 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                |                                             | 0.0             | 0.1                                         |                                             | 0.1                                         | V    |
|                  |                                                                | I <sub>OH</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> = V <sub>CC</sub> or GND               | 0 to 5.5                   |                                             | ± 1.0           |                                             |                                             | ± 10.0                                      | μA   |
| I <sub>OFF</sub> | Power Off Leakage Current                                      | V <sub>OUT</sub> = 5.5 V or<br>V <sub>IN</sub> = 5.5 V | 0                          |                                             |                 | 1                                           |                                             | 10                                          | μA   |
| I <sub>CC</sub>  | Quiescent Supply Current                                       | V <sub>IN</sub> = V <sub>CC</sub> or GND               | 1.65 to 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 |              | Unit |
|---------------------------------------|---------------------------------------|------------------------------------------------|---------------------|-----------------------|------------|-------------|-------------------------------|--------------|------|
|                                       |                                       |                                                |                     | Min                   | Typ        | Max         | Min                           | Max          |      |
| t <sub>PLH</sub><br>t <sub>PHL7</sub> | Propagation Delay<br>(Figure 3 and 4) | R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF  | 1.65<br>1.8         | 2.0<br>2.0            | 5.3<br>4.4 | 11.4<br>9.5 | 2.0<br>2.0                    | 12.0<br>10.0 | ns   |
|                                       |                                       | R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF  | 2.5 ± 0.2           | 0.2                   | 3.5        | 6.5         | 0.8                           | 7.0          |      |
|                                       |                                       | R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF  | 3.3 ± 0.3           | 0.8                   | 2.1        | 4.5         | 0.5                           | 4.7          |      |
|                                       |                                       | R <sub>L</sub> = 500 Ω, C <sub>L</sub> = 50 pF |                     | 1.2                   | 2.9        | 5.5         | 1.5                           | 5.2          |      |
|                                       |                                       | R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF  | 5.0 ± 0.5           | 0.5                   | 1.8        | 3.9         | 0.5                           | 4.1          |      |
|                                       |                                       | R <sub>L</sub> = 500 Ω, C <sub>L</sub> = 50 pF |                     | 0.8                   | 2.4        | 4.3         | 0.8                           | 4.5          |      |
|                                       |                                       |                                                |                     |                       |            |             |                               |              |      |

# CAPACITIVE CHARACTERISTICS

| Symbol          | Parameter                              | Condition                                                                                                                                            | Typical | Unit |
|-----------------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------|
| 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>.

# NL17SZ04

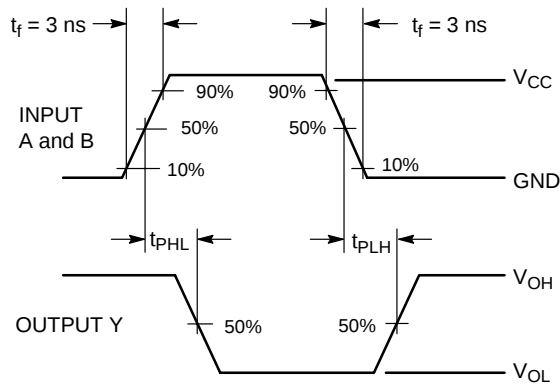
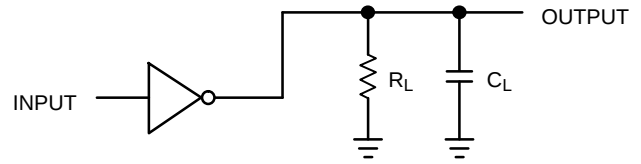


Figure 3. Switching Waveform



A 1-MHz square input wave is recommended for propagation delay tests.

Figure 4. Test Circuit

## DEVICE ORDERING INFORMATION

| Device Order Number | Device Nomenclature     |                          |                       |            |                 |                |                      | Package Type                               | Tape and Reel Size <sup>†</sup> |
|---------------------|-------------------------|--------------------------|-----------------------|------------|-----------------|----------------|----------------------|--------------------------------------------|---------------------------------|
|                     | Logic Circuit Indicator | No. of Gates per Package | Temp Range Identifier | Technology | Device Function | Package Suffix | Tape and Reel Suffix |                                            |                                 |
| NL17SZ04DFT2        | NL                      | 1                        | 7                     | SZ         | 04              | DF             | T2                   | SC-88A/<br>SOT-353/<br>SC70-5              | 178 mm,<br>3000 Unit            |
| NL17SZ04DFT2G       | NL                      | 1                        | 7                     | SZ         | 04              | DF             | T2                   | SC-88A/<br>SOT-353/<br>SC70-5<br>(Pb-Free) | 178 mm,<br>3000 Unit            |
| NL17SZ04XV5T2       | NL                      | 1                        | 7                     | SZ         | 04              | XV5            | T2                   | SOT-553*                                   | 178 mm,<br>4000 Unit            |

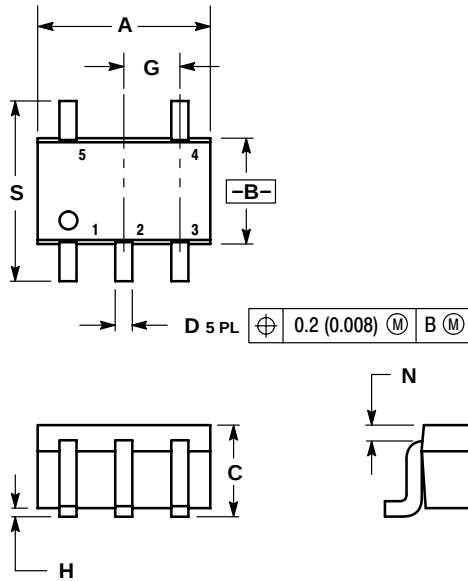
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*All Devices in Package SOT553 are Inherently Pb-Free.

# NL17SZ04

## PACKAGE DIMENSIONS

**SOT-353**  
**DF SUFFIX**  
**5-LEAD PACKAGE**  
**CASE 419A-02**  
**ISSUE G**

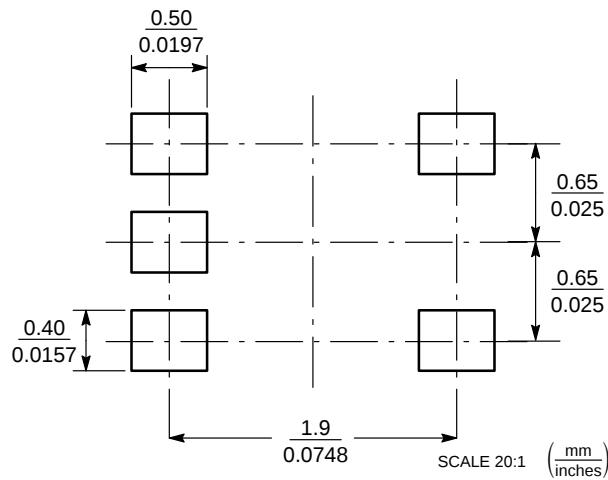


### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 419A-01 OBSOLETE. NEW STANDARD 419A-02.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.071     | 0.087 | 1.80        | 2.20 |
| B   | 0.045     | 0.053 | 1.15        | 1.35 |
| C   | 0.031     | 0.043 | 0.80        | 1.10 |
| D   | 0.004     | 0.012 | 0.10        | 0.30 |
| G   | 0.026 BSC |       | 0.65 BSC    |      |
| H   | ---       | 0.004 | ---         | 0.10 |
| J   | 0.004     | 0.010 | 0.10        | 0.25 |
| K   | 0.004     | 0.012 | 0.10        | 0.30 |
| N   | 0.008 REF |       | 0.20 REF    |      |
| S   | 0.079     | 0.087 | 2.00        | 2.20 |

## SOLDERING FOOTPRINT\*

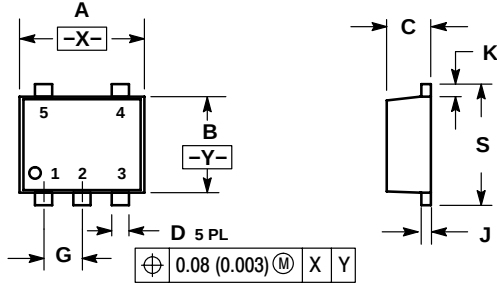


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# NL17SZ04

## PACKAGE DIMENSIONS

**SOT-553**  
**XV5 SUFFIX**  
**5-LEAD PACKAGE**  
**CASE 463B-01**  
**ISSUE A**



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 1.50        | 1.70 | 0.059     | 0.067 |
| B   | 1.10        | 1.30 | 0.043     | 0.051 |
| C   | 0.50        | 0.60 | 0.020     | 0.024 |
| D   | 0.17        | 0.27 | 0.007     | 0.011 |
| G   | 0.50 BSC    |      | 0.020 BSC |       |
| J   | 0.08        | 0.18 | 0.003     | 0.007 |
| K   | 0.10        | 0.30 | 0.004     | 0.012 |
| S   | 1.50        | 1.70 | 0.059     | 0.067 |

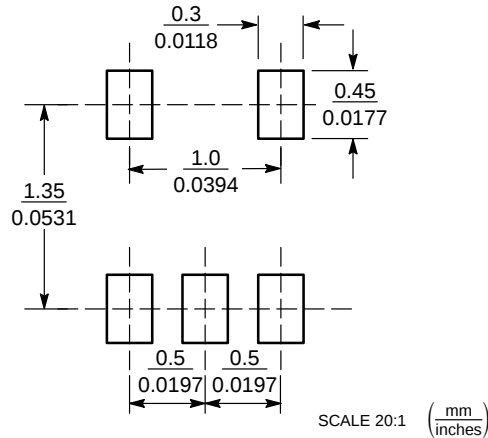
### STYLE 1:

- PIN 1. BASE 1
- EMITTER 1/2
- BASE 2
- COLLECTOR 2
- COLLECTOR 1

### STYLE 2:

- PIN 1. CATHODE
- ANODE
- CATHODE
- CATHODE
- CATHODE

## 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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