

Configurable Multifunction Gate

NL7SZ98

The NL7SZ98 is an advanced high-speed CMOS multifunction gate. The device allows the user to choose logic functions MUX, AND, OR, NAND, NOR, INVERT and BUFFER. The device has Schmitt-trigger inputs, thereby enhancing noise immunity.

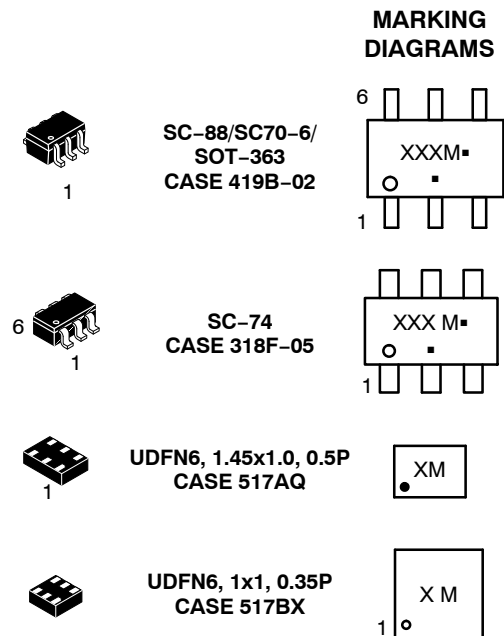
Features

- Designed for 1.65 V to 5.5 V V_{CC} Operation
- 3.3 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
- Sink 24 mA at 3.0 V
- Available in SC-88, SC-74 and UDFN6 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



ON Semiconductor®

www.onsemi.com



XXX = 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.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

NL7SZ98

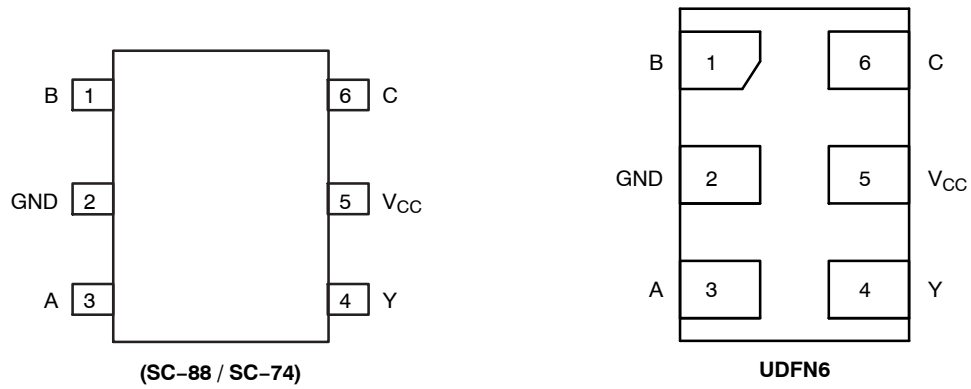


Figure 1. Pinout (Top View)

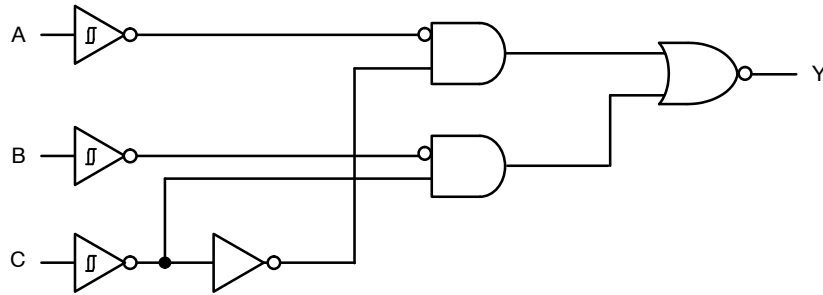


Figure 2. Function Diagram

PIN ASSIGNMENT

| Pin | Function |
|-----|-----------------|
| 1 | B |
| 2 | GND |
| 3 | A |
| 4 | Y |
| 5 | V _{CC} |
| 6 | C |

FUNCTION TABLE*

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

*To select a logic function, please refer to "Logic Configurations section".

LOGIC CONFIGURATIONS

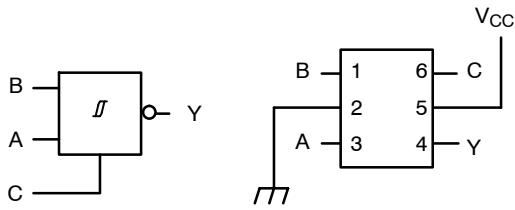


Figure 3. 2-Input MUX with Output Inverted

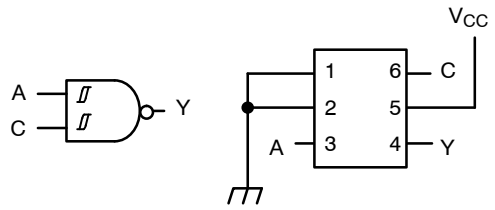


Figure 4. 2-Input NAND (When B = "L")

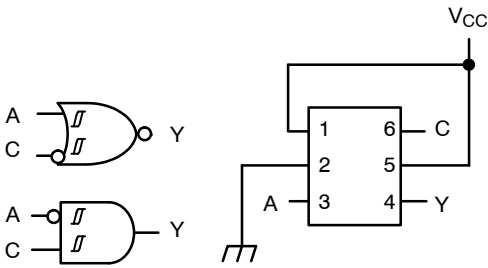


Figure 5. 2-Input NOR with Input C Inverted (When B = "H")

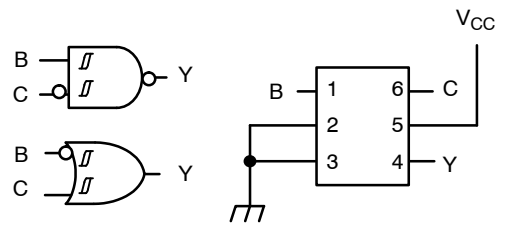


Figure 6. 2-Input NAND with Input C Inverted (When A = "L")

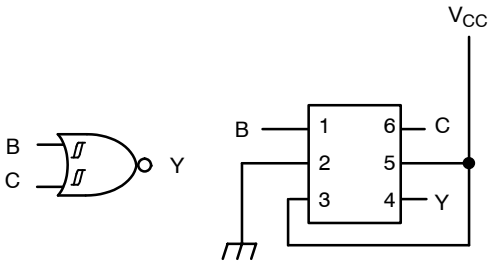


Figure 7. 2-Input NOR (When A = "H")

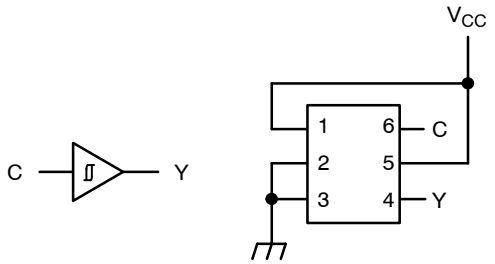


Figure 8. Buffer (When A = "L" and B = "H")

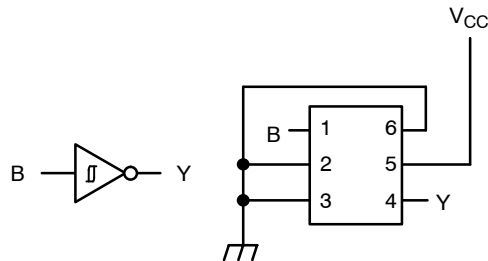


Figure 9. Inverter (When A = C = "L")

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MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit | |
|-----------------------|---|--|-------------|---------------|
| V_{CC} | DC Supply Voltage SC-88 (NLV) SC-88, SC-74, UDFN6 | -0.5 to +7.0 -0.5 to +6.5 | V | |
| V_{IN} | DC Input Voltage SC-88 (NLV) SC-88, SC-74, UDFN6 | -0.5 to +7.0 -0.5 to +6.5 | V | |
| V_{OUT} | DC Output Voltage SC-88 (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 SC-88, SC-74, UDFN6 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 | |
| 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 | $^{\circ}C$ | |
| T_L | Lead Temperature, 1 mm from Case for 10 Secs | 260 | $^{\circ}C$ | |
| T_J | Junction Temperature Under Bias | +150 | $^{\circ}C$ | |
| θ_{JA} | Thermal Resistance (Note 2) | SC-88 | 377 | $^{\circ}C/W$ |
| | | SC-74 | 320 | |
| | | UDFN6 | 154 | |
| P_D | Power Dissipation in Still Air | SC-88 | 332 | mW |
| | | SC-74 | 390 | |
| | | UDFN6 | 812 | |
| MSL | Moisture Sensitivity | Level 1 | | |
| F_R | Flammability Rating Oxygen Oxygen Index: 28 to 34 | UL 94 V-0 @ 0.125 in | | |
| V_{ESD} | ESD Withstand Voltage (Note 3) Human Body Mode Charged Device Model (NLV) Charged Device Model | >2000 | V | |
| | | >200 | | |
| | | N/A | | |
| $I_{LATCHUP}$ | Latchup Performance (Note 4) (NLV) | ± 500 ± 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-1 inch, 2 ounce copper trace no air flow per JESD51-7.
3. 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 | Parameter | 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 | 5.5 | V |
| | | | | |
| | | | | |
| T_A | Operating Free-Air Temperature | -55 | +125 | $^{\circ}C$ |
| t_r, t_f | Input Rise or Fall Rate $V_{CC} = 1.65$ 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 | No Limit | nS/V |
| | | 0 | No Limit | |
| | | 0 | No Limit | |
| | | 0 | No Limit | |

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 | Condition | V _{CC} (V) | T _A = 25°C | | | -40°C ≤ T _A ≤ 85°C | | -55°C ≤ T _A ≤ 125°C | | Unit |
|------------------|---|---|------------------------|-----------------------|-----------------|------|-------------------------------|------|--------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| V _{T+} | Positive Input Threshold Voltage | | 1.65 | - | - | 1.4 | - | 1.4 | - | 1.4 | V |
| | | | 2.3 | - | - | 1.8 | - | 1.8 | - | 1.8 | |
| | | | 3.0 | - | - | 2.2 | - | 2.2 | - | 2.2 | |
| | | | 4.5 | - | - | 3.1 | - | 3.1 | - | 3.1 | |
| | | | 5.5 | - | - | 3.6 | - | 3.6 | - | 3.6 | |
| V _{T-} | Negative Input Threshold Voltage | | 1.65 | 0.2 | - | - | 0.2 | - | 0.2 | - | V |
| | | | 2.3 | 0.4 | - | - | 0.4 | - | 0.4 | - | |
| | | | 3.0 | 0.6 | - | - | 0.6 | - | 0.6 | - | |
| | | | 4.5 | 1.0 | - | - | 1.0 | - | 1.0 | - | |
| | | | 5.5 | 1.2 | - | - | 1.2 | - | 1.2 | - | |
| V _H | Input Hysteresis Voltage | | 1.65 | 0.1 | 0.48 | 0.9 | 0.1 | 0.9 | 0.1 | - | V |
| | | | 2.3 | 0.25 | 0.75 | 1.1 | 0.25 | 1.1 | 0.25 | - | |
| | | | 3 | 0.4 | 0.93 | 1.2 | 0.4 | 1.2 | 0.4 | - | |
| | | | 4.5 | 0.6 | 1.2 | 1.5 | 0.6 | 1.5 | 0.6 | - | |
| | | | 5.5 | 0.7 | 1.4 | 1.7 | 0.7 | 1.7 | 0.7 | - | |
| V _{OH} | High-Level Output Voltage V _{IN} = V _{IH} or V _{IL} | I _{OH} = -50 μA | 1.65 to 5.5 | V _{CC} - 0.1 | V _{CC} | - | V _{CC} - 0.1 | - | V _{CC} - 0.1 | - | V |
| | | I _{OH} = -4 mA | 1.65 | 1.20 | 1.52 | - | 1.20 | - | 1.20 | - | |
| | | I _{OH} = -8 mA | 2.3 | 1.9 | 2.1 | - | 1.9 | - | 1.9 | - | |
| | | I _{OH} = -16 mA | 3 | 2.4 | 2.7 | - | 2.4 | - | 2.4 | - | |
| | | I _{OH} = -24 mA | 3 | 2.3 | 2.5 | - | 2.3 | - | 2.3 | - | |
| | | I _{OH} = -32 mA | 4.5 | 3.8 | 4 | - | 3.8 | - | 3.8 | - | |
| V _{OL} | Low-Level Output Voltage V _{IN} = V _{IH} or V _{IL} | I _{OL} = 100 μA | 1.65 to 5.5 | - | - | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _{OL} = 4 mA | 1.65 | - | 0.08 | 0.45 | - | 0.45 | - | 0.45 | |
| | | I _{OL} = 8 mA | 2.3 | - | 0.2 | 0.3 | - | 0.3 | - | 0.4 | |
| | | I _{OL} = 16 mA | 3 | - | 0.28 | 0.4 | - | 0.4 | - | 0.5 | |
| | | I _{OL} = 24 mA | 3 | - | 0.38 | 0.55 | - | 0.55 | - | 0.55 | |
| | | I _{OL} = 32 mA | 4.5 | - | 0.42 | 0.55 | - | 0.55 | - | 0.65 | |
| I _{IN} | Input Leakage Current | V _{IN} = 5.5 V or GND | 1.65 to 5.5 | - | - | +0.1 | - | +1.0 | - | +1.0 | μA |
| I _{OFF} | Power Off Leakage Current | V _{IN} = 5.5 V or V _{OUT} = 5.5 V | 0 | - | - | 1.0 | - | 10 | - | 10 | μA |
| I _{CC} | Quiescent Supply Current | V _{IN} = 5.5 V or GND | 5.5 | - | - | 1.0 | - | 10 | - | 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.

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AC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Condition | V _{CC} (V) | T _A = 25°C | | | -40°C ≤ T _A ≤ 85°C | | -55°C ≤ T _A ≤ 125°C | | Unit |
|---|------------|-----------|---------------------|--|---|--|-------------------------------|-----|--------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| | | | | t _{PLH} , t _{PHL} | Propagation Delay, (A or B or C) to Y (Figures 10 and 11) | R _L = 1 kΩ, C _L = 30 pF | 1.65 to 1.95 | - | 8.6 | 14.4 | |
| R _L = 500 Ω, C _L = 30 pF | 2.3 to 2.7 | - | 5.1 | 8.3 | | - | 8.3 | - | 8.3 | | |
| R _L = 500 Ω, C _L = 50 pF | 3.0 to 3.6 | - | 3.9 | 6.3 | | - | 6.3 | - | 6.3 | | |
| | 4.5 to 5.5 | - | 3.3 | 5.1 | | - | 5.1 | - | 5.1 | | |

CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Condition | Typical | Unit |
|------------------|--|--|------------|------|
| 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} | 4.0 | pF |
| C _{PD} | Power Dissipation Capacitance (Note 5) | 10 MHz, V _{CC} = 3.3 V, V _{IN} = 0 V or V _{CC} 10 MHz, V _{CC} = 5.0 V, V _{IN} = 0 V or V _{CC} | 16 19.5 | pF |

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 10. 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 11. 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 |

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ORDERING INFORMATION

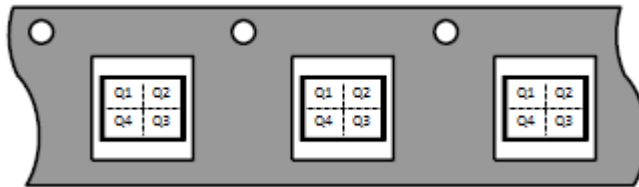
| Device | Package | | | Shipping† |
|-----------------------------------|--------------------------------------|-----|----|--------------------|
| NL7SZ98DFT2G | SC-88 (Pb-Free) | MP | Q4 | 3000 / Tape & Reel |
| NLV7SZ98DFT2G* | SC-88 (Pb-Free) | MP | Q4 | 3000 / Tape & Reel |
| NL7SZ98DBVT1G (In Development) | SC-74 (Pb-Free) | AP | Q4 | 3000 / Tape & Reel |
| NL7SZ98MU1TCG (In Development) | UDFN6, 1.45 x 1.0, 0.5P (Pb-Free) | TBD | Q4 | 3000 / Tape & Reel |
| NL7SZ98MU3TCG (In Development) | UDFN6, 1.0 x 1.0, 0.35P (Pb-Free) | 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.

*NLV Prefix 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



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PACKAGE DIMENSIONS

SC-88/SC70-6/SOT-363
CASE 419B-02
ISSUE Y

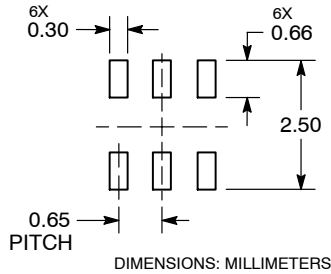


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.20 PER END.
4. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AND DATUM H.
5. DATUMS A AND B ARE DETERMINED AT DATUM H.
6. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08 AND 0.15 FROM THE TIP.
7. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF DIMENSION b AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|-----------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | --- | --- | 1.10 | --- | --- | 0.043 |
| A1 | 0.00 | --- | 0.10 | 0.000 | --- | 0.004 |
| A2 | 0.70 | 0.90 | 1.00 | 0.027 | 0.035 | 0.039 |
| b | 0.15 | 0.20 | 0.25 | 0.006 | 0.008 | 0.010 |
| C | 0.08 | 0.15 | 0.22 | 0.003 | 0.006 | 0.009 |
| D | 1.80 | 2.00 | 2.20 | 0.070 | 0.078 | 0.086 |
| E | 2.00 | 2.10 | 2.20 | 0.078 | 0.082 | 0.086 |
| E1 | 1.15 | 1.25 | 1.35 | 0.045 | 0.049 | 0.053 |
| e | 0.65 BSC | | | 0.026 BSC | | |
| L | 0.26 | 0.36 | 0.46 | 0.010 | 0.014 | 0.018 |
| L2 | 0.15 BSC | | | 0.006 BSC | | |
| aaa | 0.15 | | | 0.006 | | |
| bbb | 0.30 | | | 0.012 | | |
| ccc | 0.10 | | | 0.004 | | |
| ddd | 0.10 | | | 0.004 | | |

RECOMMENDED SOLDERING FOOTPRINT*

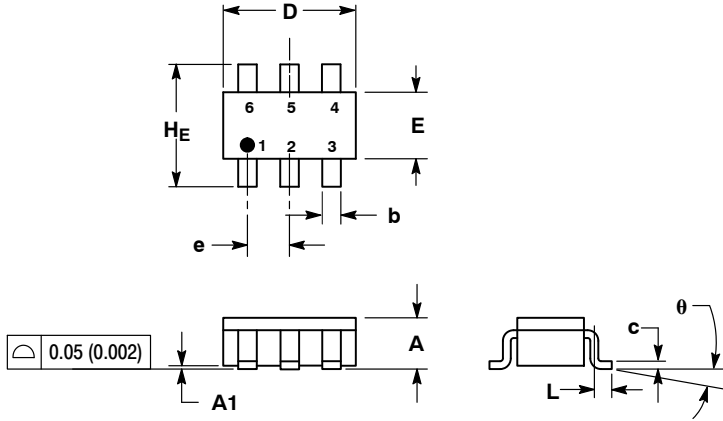


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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PACKAGE DIMENSIONS

SC-74
CASE 318F-05
ISSUE N

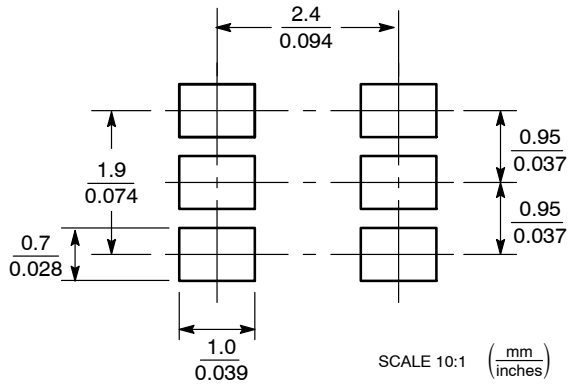


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318F-01, -02, -03, -04 OBSOLETE. NEW STANDARD 318F-05.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|--------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.90 | 1.00 | 1.10 | 0.035 | 0.039 | 0.043 |
| A1 | 0.01 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| b | 0.25 | 0.37 | 0.50 | 0.010 | 0.015 | 0.020 |
| c | 0.10 | 0.18 | 0.26 | 0.004 | 0.007 | 0.010 |
| D | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| E | 1.30 | 1.50 | 1.70 | 0.051 | 0.059 | 0.067 |
| e | 0.85 | 0.95 | 1.05 | 0.034 | 0.037 | 0.041 |
| L | 0.20 | 0.40 | 0.60 | 0.008 | 0.016 | 0.024 |
| HE | 2.50 | 2.75 | 3.00 | 0.099 | 0.108 | 0.118 |
| θ | 0° | - | 10° | 0° | - | 10° |

SOLDERING FOOTPRINT*

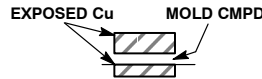
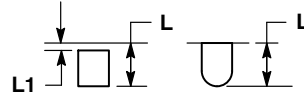


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NL7SZ98

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



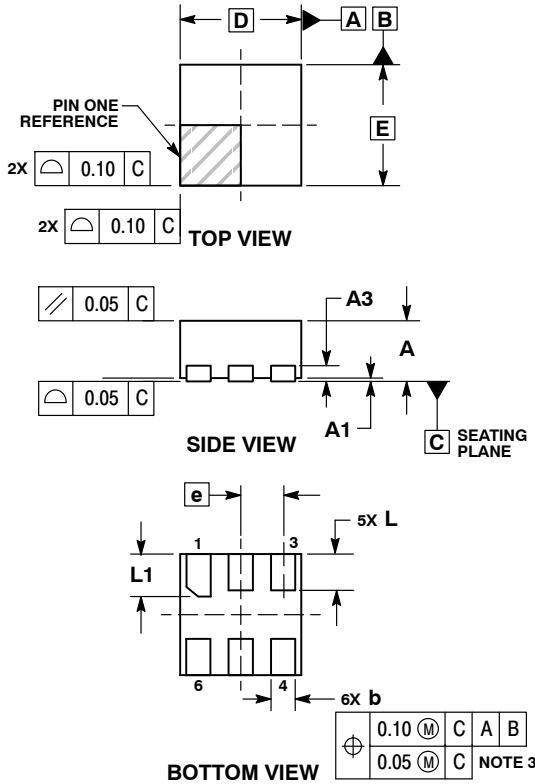
DIMENSIONS: MILLIMETERS

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

NL7SZ98

PACKAGE DIMENSIONS

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

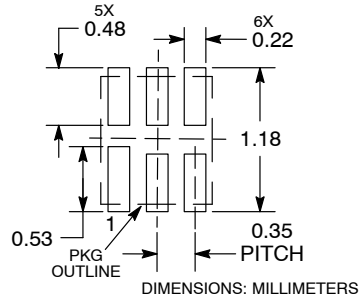


NOTES:

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 ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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