

NL7SZ98

Configurable Multifunction Gate

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.

The NL7SZ98 input and output structures provide protection when voltages up to 7.0 V are applied, regardless of the supply voltage.

Features

- High Speed: $t_{PD} = 3.4$ ns (Typ) @ $V_{CC} = 5.0$ V
- Low Power Dissipation: $I_{CC} = 1$ μ A (Maximum) at $T_A = 25^\circ$ C
- Power Down Protection Provided on inputs
- Balanced Propagation Delays
- Overvoltage Tolerant (OVT) Input and Output Pins
- Ultra-Small Package
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- This is a Pb-Free Device



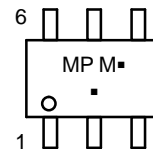
ON Semiconductor[®]

<http://onsemi.com>



**SC-88 (SOT-363)
CASE 419B**

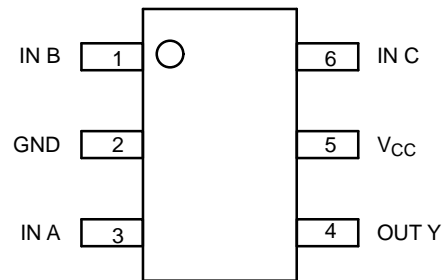
MARKING DIAGRAM



MP = Specific Device Code
M = Date Code
▪ = Pb-Free Package

(Note: Microdot may be in either location)

PIN ASSIGNMENTS



(Top View)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

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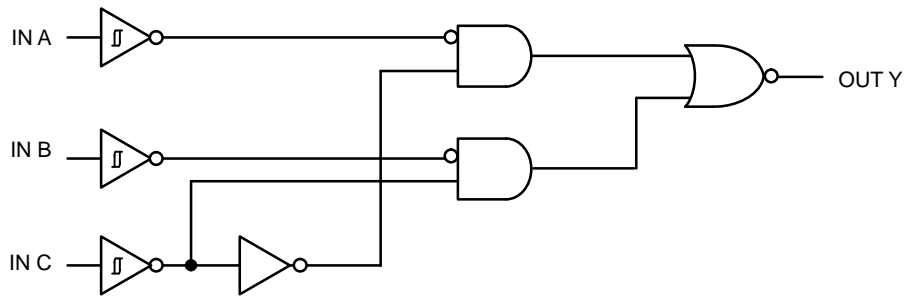


Figure 1. Function Diagram

PIN ASSIGNMENT

| | |
|---|-----------------|
| 1 | IN B |
| 2 | GND |
| 3 | IN A |
| 4 | OUT Y |
| 5 | V _{CC} |
| 6 | IN 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".

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LOGIC CONFIGURATIONS

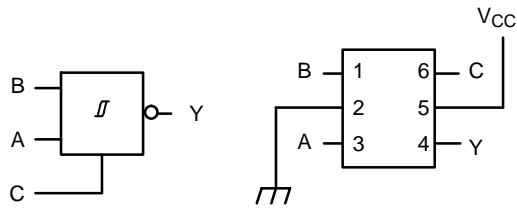


Figure 2. 2-Input MUX with Output Inverted

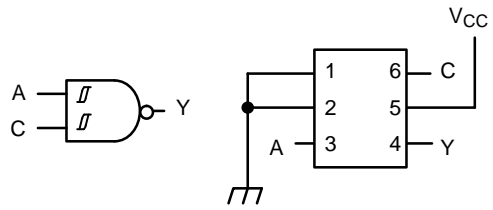


Figure 3. 2-Input NAND (When B = "L")

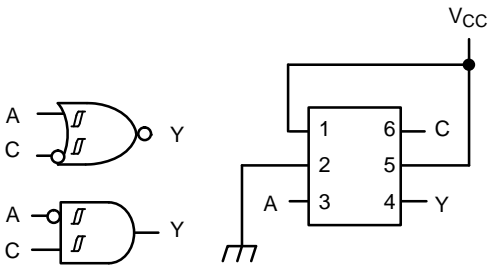


Figure 4. 2-Input NOR with Input C Inverted (When B = "H")

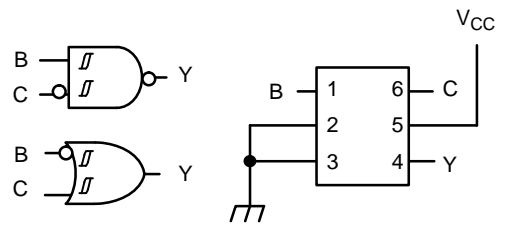


Figure 5. 2-Input NAND with Input C Inverted (When A = "L")

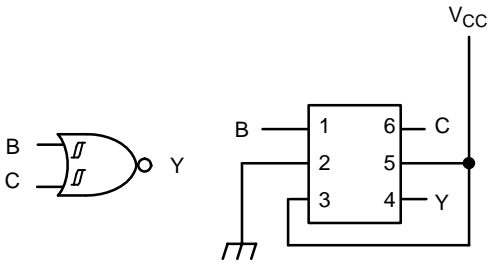


Figure 6. 2-Input NOR (When A = "H")

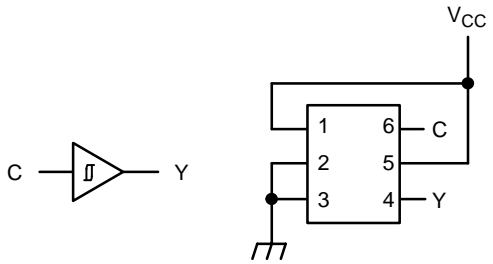


Figure 7. Buffer (When A = "L" and B = "H")

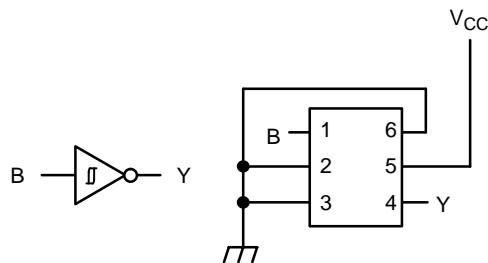


Figure 8. Inverter (When A = C = "L")

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MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|----------------------|--|----------------------|------|
| V _{CC} | DC Supply Voltage | -0.5 to +7.0 | V |
| V _{IN} | DC Input Voltage | -0.5 to +7.0 | V |
| V _{OUT} | DC Output Voltage | -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 _O | DC Output Source/Sink Current | ± 50 | mA |
| I _{CC} | DC Supply Current Per Supply Pin | ± 100 | mA |
| I _{GND} | DC Ground Current per Ground Pin | ± 100 | mA |
| T _{STG} | Storage Temperature Range | -65 to +150 | °C |
| T _L | Lead Temperature, 1 mm from Case for 10 Seconds | 260 | °C |
| T _J | Junction Temperature Under Bias | +150 | °C |
| θ _{JA} | Thermal Resistance (Note 1) SC-88 | 350 | °C/W |
| P _D | Power Dissipation in Still Air at 85°C SC-88 | 200 | 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 Human Body Mode (Note 2) Machine Model (Note 3) Charged Device Model (Note 4) | >2000 >200 N/A | V |
| I _{LATCHUP} | Latchup Performance Above V _{CC} and Below GND at 125°C (Note 5) | ± 500 | 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. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2 ounce copper trace no air flow.
2. Tested to EIA/JESD22-A114-A.
3. Tested to EIA/JESD22-A115-A.
4. Tested to JESD22-C101-A.
5. Tested to EIA/JESD78.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|------------------|---|-------------|----------------------------------|------|
| V _{CC} | Positive DC Supply Voltage | 1.65 | 5.5 | V |
| V _{IN} | Digital Input Voltage | 0 | 5.5 | V |
| V _{OUT} | Output Voltage | 0 | 5.5 | V |
| T _A | Operating Free-Air Temperature | -55 | +125 | °C |
| Δt/ΔV | Input Transition Rise or Fall Rate V _{CC} = 2.5 V ± 0.2 V V _{CC} = 3.3 V ± 0.3 V V _{CC} = 5.0 V ± 0.5 V | 0 0 0 | No Limit No Limit No Limit | 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 ≤ +85°C | | T _A = -55°C to +125°C | | Unit |
|-----------------|-----------------------------------|--|------------------------|-----------------------|-----|------|------------------------|------|----------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| V _{T+} | Positive Threshold Voltage | | 1.65 | 0.79 | | 1.16 | | 1.16 | | 1.16 | V |
| | | | 2.3 | 1.11 | | 1.56 | | 1.56 | | 1.56 | |
| | | | 3.0 | 1.5 | | 1.87 | | 1.87 | | 1.87 | |
| | | | 4.5 | 2.16 | | 2.74 | | 2.74 | | 2.74 | |
| | | | 5.5 | 2.61 | | 3.33 | | 3.33 | | 3.33 | |
| V _{T-} | Negative Threshold Voltage | | 1.65 | 0.35 | | 0.62 | 0.35 | | 0.35 | | V |
| | | | 2.3 | 0.58 | | 0.87 | 0.58 | | 0.58 | | |
| | | | 3.0 | 0.84 | | 1.19 | 0.84 | | 0.84 | | |
| | | | 4.5 | 1.41 | | 1.9 | 1.41 | | 1.41 | | |
| | | | 5.5 | 1.78 | | 2.29 | 1.78 | | 1.78 | | |
| V _H | Hysteresis Voltage | | 1.65 | 0.30 | | 0.62 | 0.30 | 0.62 | 0.30 | 0.62 | V |
| | | | 2.3 | 0.40 | | 0.8 | 0.40 | 0.8 | 0.40 | 0.8 | |
| | | | 3.0 | 0.53 | | 0.87 | 0.53 | 0.87 | 0.53 | 0.87 | |
| | | | 4.5 | 0.71 | | 1.04 | 0.71 | 1.04 | 0.71 | 1.04 | |
| | | | 5.5 | 0.8 | | 1.2 | 0.8 | 1.2 | 0.8 | 1.2 | |
| V _{OH} | Minimum High-Level Output Voltage | V _{IN} ≤ V _{T-MIN} I _{OH} = -50 μA | 1.65 – 5.5 | V _{CC} – 0.1 | | | V _{CC} – 0.1 | | V _{CC} – 0.1 | | V |
| | | V _{IN} ≤ V _{T-MIN} I _{OH} = -4 mA | 1.65 | 1.2 | | | 1.2 | | 1.2 | | |
| | | I _{OH} = -8 mA | 2.3 | 1.9 | | | 1.9 | | 1.9 | | |
| | | I _{OH} = -16 mA | 3.0 | 2.4 | | | 2.4 | | 2.4 | | |
| | | I _{OH} = -24 mA | 3.0 | 2.3 | | | 2.3 | | 2.3 | | |
| | | I _{OH} = -32 mA | 4.5 | 3.8 | | | 3.8 | | 3.8 | | |
| | | | | | | | | | | | |
| V _{OL} | Maximum Low-Level Output Voltage | V _{IN} ≥ V _{T+MAX} I _{OL} = 50 μA | 1.65 – 5.5 | | | 0.1 | | 0.1 | | 0.1 | V |
| | | V _{IN} ≥ V _{T+MAX} I _{OL} = 4 mA | 1.65 | | | 0.45 | | 0.45 | | 0.45 | |
| | | I _{OL} = 8 mA | 2.3 | | | 0.3 | | 0.3 | | 0.3 | |
| | | I _{OL} = 16 mA | 3.0 | | | 0.4 | | 0.4 | | 0.4 | |
| | | I _{OL} = 24 mA | 3.0 | | | 0.55 | | 0.55 | | 0.55 | |
| | | I _{OL} = 32 mA | 4.5 | | | 0.55 | | 0.55 | | 0.55 | |
| | | | | | | | | | | | |
| I _{IN} | Input Leakage Current | 0 ≤ V _{IN} ≤ 5.5 V | 0 to 5.5 | | | ±0.1 | | ±1.0 | | ±1.0 | μA |
| I _{CC} | Quiescent Supply Current | 0 ≤ V _{IN} ≤ V _{CC} | 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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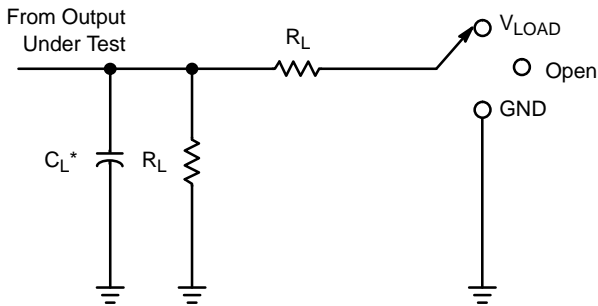
AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns)

| Symbol | Parameter | V_{CC} (V) | Test Condition | $T_A = 25^\circ\text{C}$ | | | $T_A \leq +85^\circ\text{C}$ | | $T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$ | | Unit |
|--------------------------|---|--------------|----------------|--------------------------|-----|------|------------------------------|------|--|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| t_{PLH} , t_{PHL} | Propagation Delay, Any Input to Output Y (See Test Circuit) | 1.65 – 1.95 | | 3.2 | 8.9 | 14.4 | 3.2 | 14.4 | 3.2 | 14.4 | ns |
| | | 2.3 – 2.7 | | 2.0 | 5.2 | 8.3 | 2.0 | 8.3 | 2.0 | 8.3 | |
| | | 3.0 – 3.6 | | 1.5 | 4.0 | 6.3 | 1.5 | 6.3 | 1.5 | 6.3 | |
| | | 4.5 – 5.5 | | 1.1 | 3.4 | 5.1 | 1.1 | 5.1 | 1.1 | 5.1 | |
| C_{IN} | Input Capacitance | | | | 3.5 | | | | | | pF |
| C_{PD} | Power Dissipation Capacitance (Note 6) | 5.0 | $f = 10$ MHz | | 22 | | | | | | 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.

6. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the dynamic operating current consumption without load. Average operating current can be obtained by the equation $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}$. C_{PD} is used to determine the no-load dynamic power consumption: $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_{in} + I_{CC} \cdot V_{CC}$.

TEST CIRCUIT AND VOLTAGE WAVEFORMS



| Test | S1 |
|-------------------|------------|
| t_{PLH}/t_{PHL} | Open |
| t_{PLZ}/t_{PZL} | V_{LOAD} |
| t_{PHZ}/t_{PZH} | GND |

* C_L includes probes and jig capacitance.

Figure 9. Load Circuit

| V_{CC} | Inputs | | V_M | V_{LOAD} | C_L | R_L | V_A |
|----------------------------------|----------|---------------|------------|-------------------|-------|--------------|--------|
| | V_I | t_r/t_f | | | | | |
| $1.8\text{ V} \pm 0.15\text{ V}$ | V_{CC} | ≤ 2 ns | $V_{CC}/2$ | $2 \times V_{CC}$ | 30 pF | 1 k Ω | 0.15 V |
| $2.5\text{ V} \pm 0.2\text{ V}$ | V_{CC} | ≤ 2 ns | $V_{CC}/2$ | $2 \times V_{CC}$ | 30 pF | 500 Ω | 0.15 V |
| $3.3\text{ V} \pm 0.3\text{ V}$ | 3 V | ≤ 2.5 ns | 1.5 V | 6 V | 50 pF | 500 Ω | 0.3 V |
| $5.5\text{ V} \pm 0.5\text{ V}$ | V_{CC} | ≤ 2.5 ns | $V_{CC}/2$ | $2 \times V_{CC}$ | 50 pF | 500 Ω | 0.3 V |

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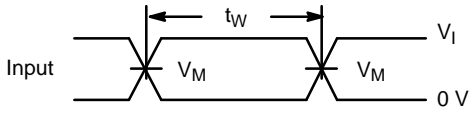


Figure 10. Voltage Waveforms Pulse Duration

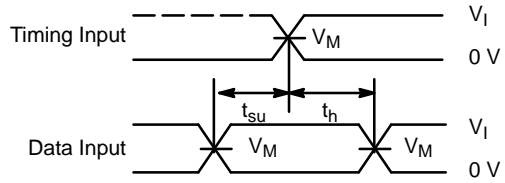


Figure 11. Voltage Waveforms Setup and Hold Times

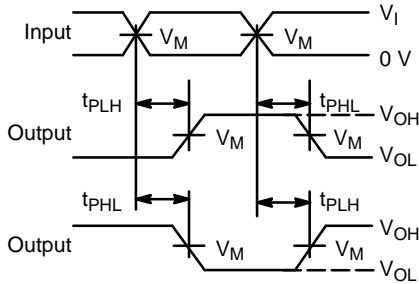


Figure 12. Voltage Waveforms Propagation Delay Times Inverting and Noninverting Outputs

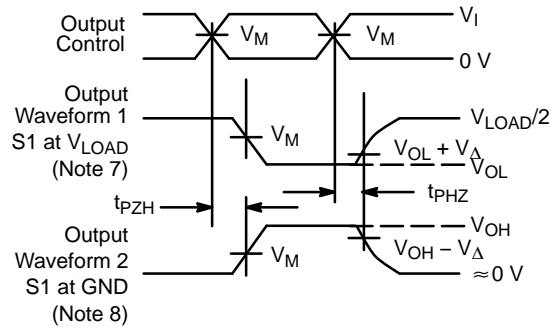


Figure 13. Voltage Waveforms Enable and Disable Times Low- and High-Level Enabling

7. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control.
8. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
9. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$.
10. The outputs are measured one at a time, with one transition per measurement.
11. All parameters are waveforms are not applicable to all devices.

ORDERING INFORMATION

| Device | Package | Shipping† |
|----------------|--------------------|--------------------|
| NL7SZ98DFT2G | SC-88 (Pb-Free) | 3000 / Tape & Reel |
| NLV7SZ98DFT2G* | | |

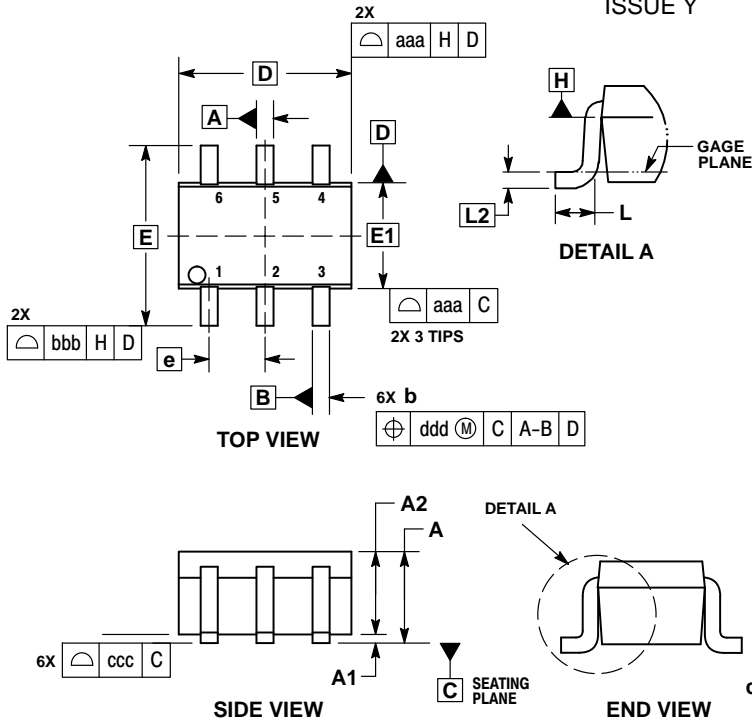
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

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PACKAGE DIMENSIONS

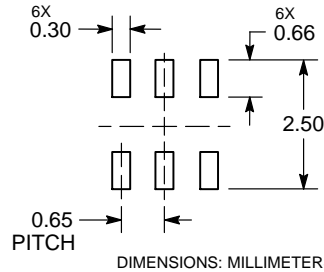
SC-88/SC70-6/SOT-363
CASE 419B-02
ISSUE Y




- 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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