

# NB3N551

## 3.3 V / 5.0 V Ultra-Low Skew 1:4 Clock Fanout Buffer

### Description

The NB3N551 is a low skew 1-to 4 clock fanout buffer, designed for clock distribution in mind. The NB3N551 specifically guarantees low output-to-output skew. Optimal design, layout and processing minimize skew within a device and from device to device.

The output enable (OE) pin three-states the outputs when low.

### Features

- Input/Output Clock Frequency up to 180 MHz
- Low Skew Outputs (50 ps typical)
- RMS Phase Jitter (12 kHz – 20 MHz): 43 fs (Typical)
- Output goes to Three-State Mode via OE
- Operating Range:  $V_{DD} = 3.0\text{ V to }5.5\text{ V}$
- Ideal for Networking Clocks
- Packaged in 8-pin SOIC
- Industrial Temperature Range
- These are Pb-Free Devices

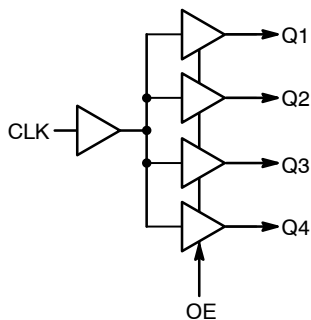


Figure 1. Block Diagram



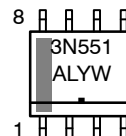
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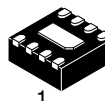
### MARKING DIAGRAMS\*



SOIC-8  
D SUFFIX  
CASE 751



3N551 = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package



DFN8  
MN SUFFIX  
CASE 506AA

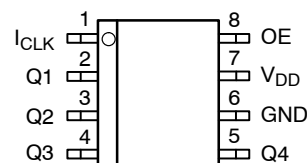


6K = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*For additional marking information, refer to Application Note AND8002/D.

### PIN CONNECTIONS



### ORDERING INFORMATION

| Device       | Package             | Shipping†        |
|--------------|---------------------|------------------|
| NB3N551DG    | SOIC-8<br>(Pb-Free) | 98 Units/Rail    |
| NB3N551DR2G  | SOIC-8<br>(Pb-Free) | 2500/Tape & Reel |
| NB3N551MNR4G | DFN-8<br>(Pb-Free)  | 1000/Tape & Reel |

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

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**Table 1. OE, OUTPUT ENABLE FUNCTION**

| OE | Function |
|----|----------|
| 0  | Disable  |
| 1  | Enable   |

**Table 2. PIN DESCRIPTION**

| Pin # | Name             | Type                    | Description  |
|-------|------------------|-------------------------|--|
| 1     | I <sub>CLK</sub> | (LV)CMOS/(LV)TTL Input  | Clock Input. Internal pull-up resistor.  |
| 2     | Q1               | (LV)CMOS/(LV)TTL Output | Clock Output 1   |
| 3     | Q2               | (LV)CMOS/(LV)TTL Output | Clock Output 2   |
| 4     | Q3               | (LV)CMOS/(LV)TTL Output | Clock Output 3   |
| 5     | Q4               | (LV)CMOS/(LV)TTL Output | Clock Output 4   |
| 6     | GND              | Power                   | Negative supply voltage; Connect to ground, 0 V  |
| 7     | V <sub>DD</sub>  | Power                   | Positive supply voltage (3.0 V to 5.5 V)   |
| 8     | OE               | (LV)CMOS/(LV)TTL Input  | Output Enable for the clock outputs. Outputs are enabled when HIGH or when left open; OE pin has internal pull-up resistor. Three-states outputs when LOW.                     |
| -     | EP               | Thermal Exposed Pad     | (DFN8 only) Thermal exposed pad must be connected to a sufficient thermal conduit. Electrically connect to the most negative supply (GND) or leave unconnected, floating open. |

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**Table 3. MAXIMUM RATINGS**

| Symbol           | Parameter                                | Condition 1        | Condition 2  | Rating  | Units        |
|------------------|--|--------------------|--------------|---|--------------|
| V <sub>DD</sub>  | Positive Power Supply                    | GND = 0 V          | –            | 7.0   | V            |
| V <sub>I/O</sub> | Input/Output Voltage                     | t ≤ 1.5 ns         | –            | GND–1.5 ≤ V <sub>I/O</sub> ≤ V <sub>DD</sub> +1.5 | V            |
| T <sub>A</sub>   | Operating Temperature Range, Industrial  | –                  | –            | ≥ –40 to ≤ +85                                    | °C           |
| T <sub>stg</sub> | Storage Temperature Range                | –                  | –            | –65 to +150                                       | °C           |
| θ <sub>JA</sub>  | Thermal Resistance (Junction–to–Ambient) | 0 lfpm<br>500 lfpm | SOIC–8       | 190<br>130  | °C/W<br>°C/W |
| θ <sub>JC</sub>  | Thermal Resistance (Junction–to–Case)    | (Note 1)           | SOIC–8       | 41 to 44  | °C/W         |
| θ <sub>JA</sub>  | Thermal Resistance (Junction–to–Ambient) | 0 lfpm<br>500 lfpm | DFN8<br>DFN8 | 129<br>84   | °C/W         |
| θ <sub>JC</sub>  | Thermal Resistance (Junction–to–Case)    | (Note 1)           | DFN8         | 35 to 40  | °C/W         |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. JEDEC standard multilayer board – 2S2P (2 signal, 2 power)

**Table 4. ATTRIBUTES**

| Characteristic  | Value  |
|---|--|
| ESD Protection  | Human Body Model<br>Machine Model<br>> 4 kV<br>> 200 V |
| Moisture Sensitivity, Indefinite Time Out of Drypack (Note 2) | Level 1  |
| Flammability Rating   | Oxygen Index: 28 to 34<br>UL–94 code V–0 @ 0.125 in    |
| Transistor Count  | 531 Devices  |
| Meets or Exceeds JEDEC Standard EIA/JESD78 IC Latchup Test    |  |

2. For additional Moisture Sensitivity information, refer to Application Note AND8003/D.

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**Table 5. DC CHARACTERISTICS** ( $V_{DD} = 3.0\text{ V to }3.6\text{ V}$ ,  $GND = 0\text{ V}$ ,  $T_A = -40^\circ\text{C to }+85^\circ\text{C}$ ) (Note 3)

| Symbol            | Characteristic   | Min              | Typ      | Max              | Unit       |
|-------------------|--|------------------|----------|------------------|------------|
| $I_{DD}$          | Power Supply Current @ 135 MHz, No Load, $V_{DD} = 3.3\text{ V}$         | –                | 20       | 40               | mA         |
| $V_{OH}$          | Output HIGH Voltage – $I_{OH} = -25\text{ mA}$ , $V_{DD} = 3.3\text{ V}$ | 2.4              | –        | –                | V          |
| $V_{OL}$          | Output LOW Voltage – $I_{OL} = 25\text{ mA}$                             | –                | –        | 0.4              | V          |
| $V_{OH}$          | Output HIGH Voltage – $I_{OH} = -12\text{ mA}$ (CMOS level)              | $V_{DD} - 0.4$   | –        | –                | V          |
| $V_{IH}, I_{CLK}$ | Input HIGH Voltage, $I_{CLK}$  | $(V_{DD}/2)+0.7$ | –        | 3.8              | V          |
| $V_{IL}, I_{CLK}$ | Input LOW Voltage, $I_{CLK}$   | –                | –        | $(V_{DD}/2)-0.7$ | V          |
| $V_{IH}, OE$      | Input HIGH Voltage, OE   | 2.0              | –        | $V_{DD}$         | V          |
| $V_{IL}, OE$      | Input LOW Voltage, OE  | 0                | –        | 0.8              | V          |
| ZO                | Nominal Output Impedance   | –                | 20       | –                | $\Omega$   |
| RPU               | Input Pull-up Resistor, OE   | –                | 220      | –                | k $\Omega$ |
| CIN               | Input Capacitance, OE  | –                | 5.0      | –                | pF         |
| IOS               | Short Circuit Current  | –                | $\pm 50$ | –                | mA         |

**DC CHARACTERISTICS** ( $V_{DD} = 4.5\text{ V to }5.5\text{ V}$ ,  $GND = 0\text{ V}$ ,  $T_A = -40^\circ\text{C to }+85^\circ\text{C}$ ) (Note 3)

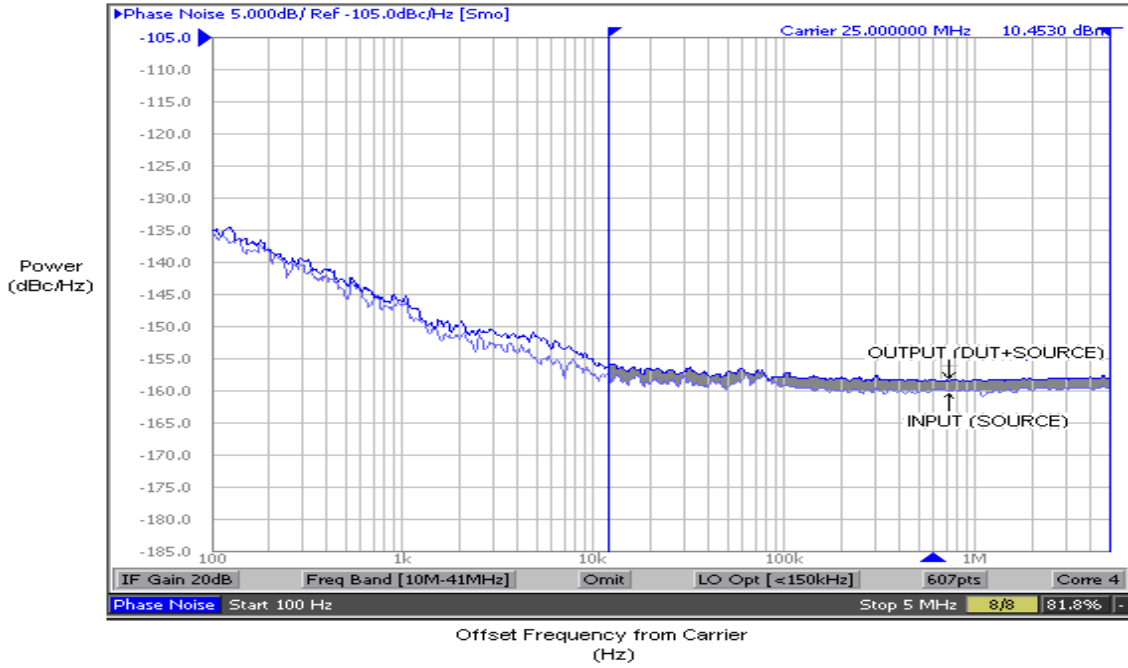
| Symbol            | Characteristic   | Min              | Typ      | Max              | Unit       |
|-------------------|--|------------------|----------|------------------|------------|
| $I_{DD}$          | Power Supply Current @ 135 MHz, No Load, $V_{DD} = 5.0\text{ V}$ | –                | 50       | 95               | mA         |
| $V_{OH}$          | Output HIGH Voltage – $I_{OH} = -35\text{ mA}$                   | 2.4              | –        | –                | V          |
| $V_{OL}$          | Output LOW Voltage – $I_{OL} = 35\text{ mA}$                     | –                | –        | 0.4              | V          |
| $V_{OH}$          | Output HIGH Voltage – $I_{OH} = -12\text{ mA}$ (CMOS level)      | $V_{DD} - 0.4$   | –        | –                | V          |
| $V_{IH}, I_{CLK}$ | Input HIGH Voltage, $I_{CLK}$                                    | $(V_{DD}/2) + 1$ | –        | 5.5              | V          |
| $V_{IL}, I_{CLK}$ | Input LOW Voltage, $I_{CLK}$                                     | –                | –        | $(V_{DD}/2) - 1$ | V          |
| $V_{IH}, OE$      | Input HIGH Voltage, OE   | 2.0              | –        | $V_{DD}$         | V          |
| $V_{IL}, OE$      | Input LOW Voltage, OE  | 0                | –        | 0.8              | V          |
| ZO                | Nominal Output Impedance   | –                | 20       | –                | $\Omega$   |
| RPU               | Input Pull-up Resistor, OE                                       | –                | 220      | –                | k $\Omega$ |
| CIN               | Input Capacitance, OE  | –                | 5.0      | –                | pF         |
| IOS               | Short Circuit Current  | –                | $\pm 80$ | –                | mA         |

**Table 6. AC CHARACTERISTICS** ( $V_{DD} = 3.0\text{ V to }5.5\text{ V}$ ,  $GND = 0\text{ V}$ ,  $T_A = -40^\circ\text{C to }+85^\circ\text{C}$ ) (Note 3)

| Symbol             | Characteristic   | Conditions   | Min    | Typ      | Max    | Unit |
|--------------------|--|--|--------|----------|--------|------|
| $f_{in}$           | Input Frequency  |  | –      | –        | 180    | MHz  |
| $t_{jitter}(\phi)$ | RMS Phase Jitter (Integrated 12 kHz – 20 MHz)<br>(See Figures 2 and 3) | $f_{carrier} = 25\text{ MHz}$<br>$f_{carrier} = 50\text{ MHz}$ | –<br>– | 43<br>16 | –<br>– | fs   |
| $t_{jitter}(pd)$   | Period Jitter (RMS, $1\sigma$ )  |  | –      | 2.0      | –      | ps   |
| $t_r/t_f$          | Output rise and fall times; 0.8 V to 2.0 V                             |  | –      | 0.5      | 1.0    | ns   |
| $t_{pd}$           | Propagation Delay, CLK to Qn, 0 – 180 MHz,<br>(Note 4)                 |  | 1.5    | 3.0      | 6.0    | ns   |
| $t_{skew}$         | Output-to-Output Skew; (Note 5)  |  | –      | 50       | 160    | ps   |

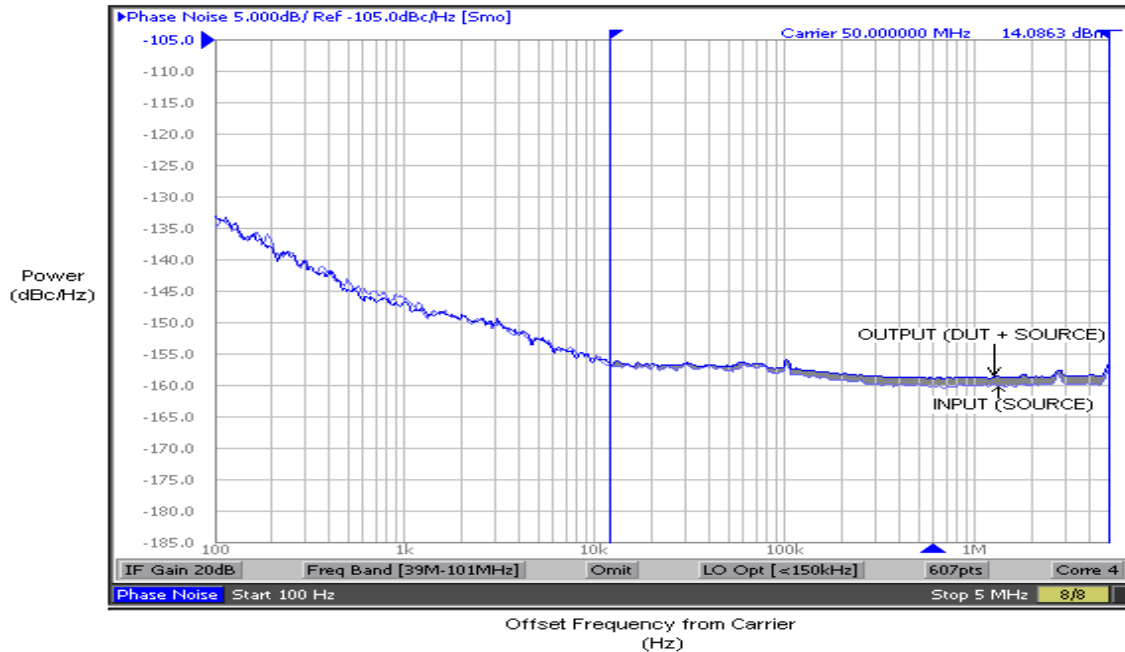
3. Outputs loaded with external  $R_L = 33\text{-}\Omega$  series resistor and  $C_L = 15\text{ pF}$  to GND. Duty cycle out = duty in. A  $0.01\text{ }\mu\text{F}$  decoupling capacitor should be connected between  $V_{DD}$  and GND. A  $33\text{ }\Omega$  series terminating resistor may be used on each clock output if the trace is longer than 1 inch.
4. Measured with rail-to-rail input clock.
5. Measured on rising edges at  $V_{DD} + 2$ .

# NB3N551



**Figure 2. Phase Noise Plot at 25 MHz at an Operating Voltage of 3.3 V, Room Temperature**

The above plot captured using Agilent E5052A shows Additive Phase Noise of the NB3N551 device measured with an input source generated by Agilent E8663B. The RMS phase jitter contributed by the device (integrated between 12 kHz to 20 MHz; as shown in the shaded region of the plot) is 43 fs (RMS Jitter of the input source is 203.31 fs and Output (DUT+Source) is 247.06 fs).



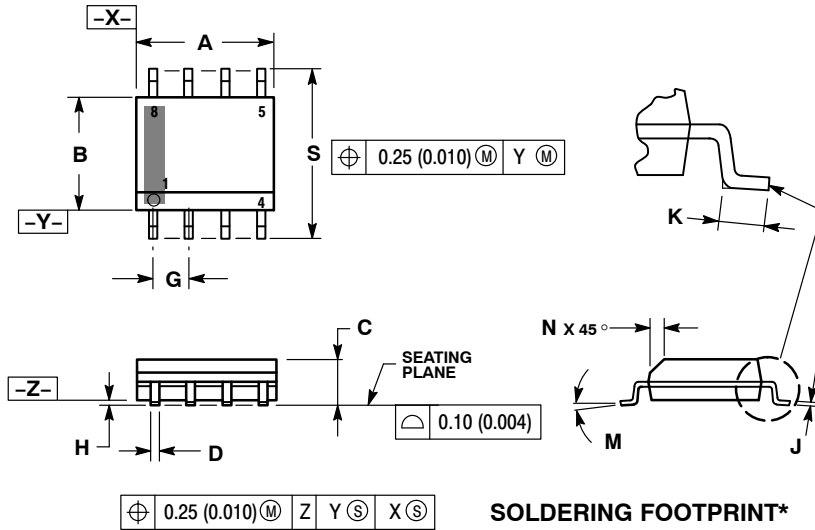
**Figure 3. Phase Noise Plot at 50 MHz at an Operating Voltage of 5 V, Room Temperature**

The above plot captured using Agilent E5052A shows Additive Phase Noise of the NB3N551 device measured with an input source generated by Agilent E8663B. The RMS phase jitter contributed by the device (integrated between 12 kHz to 20 MHz; as shown in the shaded region of the plot) is 16 fs (RMS Jitter of the input source is 104.08 fs and Output (DUT + Source) is 119.77 fs).

# NB3N551

## PACKAGE DIMENSIONS

SOIC-8 NB  
CASE 751-07  
ISSUE AK

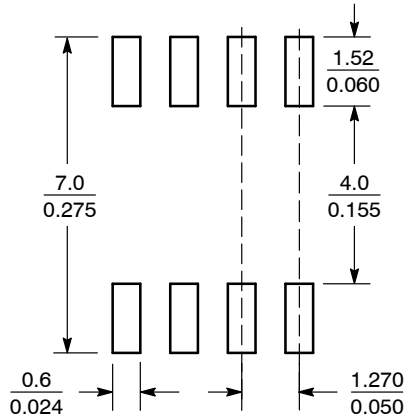


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 4.80        | 5.00 | 0.189     | 0.197 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.053     | 0.069 |
| D   | 0.33        | 0.51 | 0.013     | 0.020 |
| G   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 0.10        | 0.25 | 0.004     | 0.010 |
| J   | 0.19        | 0.25 | 0.007     | 0.010 |
| K   | 0.40        | 1.27 | 0.016     | 0.050 |
| M   | 0°          | 8°   | 0°        | 8°    |
| N   | 0.25        | 0.50 | 0.010     | 0.020 |
| S   | 5.80        | 6.20 | 0.228     | 0.244 |

**SOLDERING FOOTPRINT\***



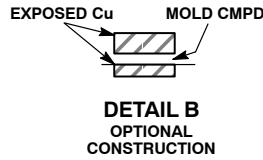
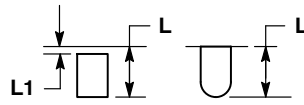
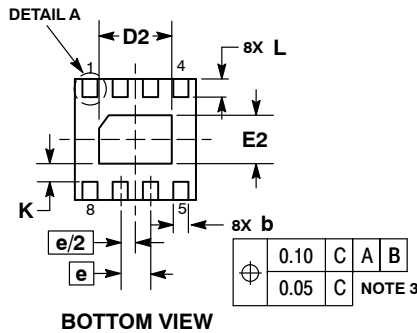
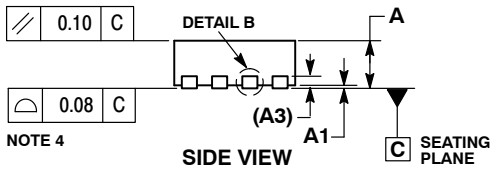
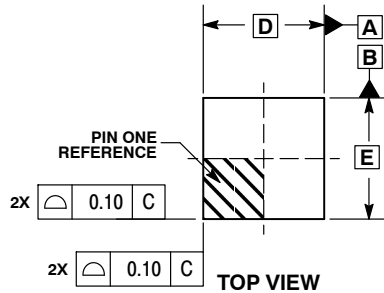
SCALE 6:1 (mm/inches)

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

# NB3N551

## PACKAGE DIMENSIONS

DFN8 2x2, 0.5P  
CASE 506AA-01  
ISSUE E

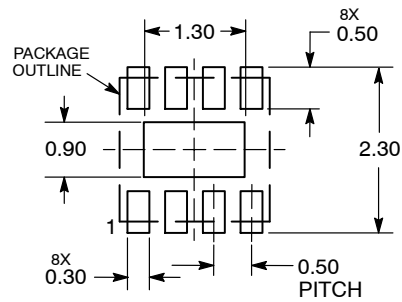


**NOTES:**

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. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 0.80        | 1.00 |
| A1  | 0.00        | 0.05 |
| A3  | 0.20 REF    |      |
| b   | 0.20        | 0.30 |
| D   | 2.00 BSC    |      |
| D2  | 1.10        | 1.30 |
| E   | 2.00 BSC    |      |
| E2  | 0.70        | 0.90 |
| e   | 0.50 BSC    |      |
| K   | 0.30 REF    |      |
| L   | 0.25        | 0.35 |
| L1  | ---         | 0.10 |

### 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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