

NL17SZU04

Single Unbuffered Inverter

The NL17SZU04 is a single unbuffered inverter in three tiny footprint packages. The device performs much as LCX multi-gate products in speed and drive.

Features

- Tiny SOT-353, SOT-553 and SOT-953 Packages
- Source/Sink ± 16 mA at 4.5 V V_{CC}
- Over-Voltage Tolerant Inputs and Outputs
- Pin For Pin with NC7SZU04P5X, TC7SZU04FU and TC7SZU04AFE
- Chip Complexity: FETs = 20
- Designed for 1.65 V to 5.5 V V_{CC} Operation
- 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

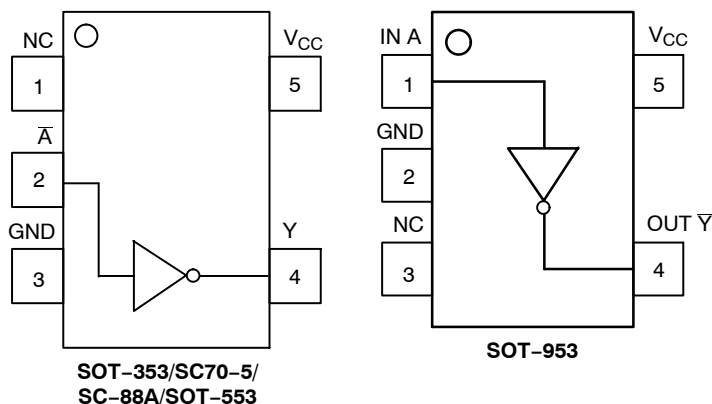


Figure 1. Pinout (Top View)

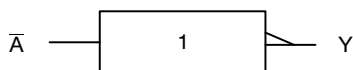


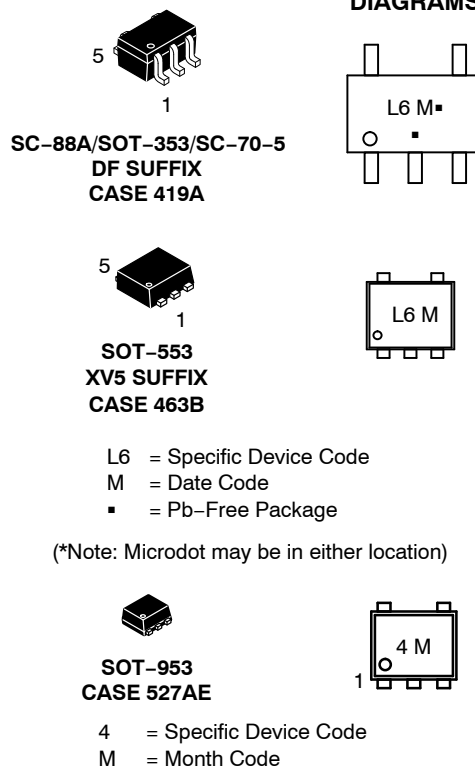
Figure 2. Logic Symbol



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MARKING DIAGRAMS



ORDERING INFORMATION

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

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PIN ASSIGNMENT (SOT-353/SC70-5/SC-88A/SOT-553)

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

PIN ASSIGNMENT (SOT-953)

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

FUNCTION TABLE

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

MAXIMUM RATINGS

| Symbol | Parameter | Value | Units |
|---------------|---|--|---------------|
| 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 (SOT-353/SC70-5/SC-88A/SOT-553 Packages) | -0.5 to $V_{CC} + 0.5$ | V |
| V_{OUT} | DC Output Voltage (SOT-953 Package) Output at High or Low State Power-Down Mode ($V_{CC} = 0$ V) | -0.5 to $V_{CC} + 0.5$ -0.5 to +0.5 | V |
| I_{IK} | DC Input Diode Current | -50 | mA |
| I_{OK} | DC Output Diode Current (SOT-353/SC70-5/SC-88A/SOT-553 Packages) $V_{OUT} < GND, V_{OUT} > V_{CC}$ | ± 50 | mA |
| I_{OK} | DC Output Diode Current (SOT-953 Package) $V_{OUT} < GND$ | -50 | mA |
| I_{OUT} | DC Output Sink Current | ± 50 | mA |
| I_{CC} | DC Supply Current per Supply Pin | ± 100 | mA |
| T_{STG} | Storage Temperature Range | -65 to +150 | $^{\circ}C$ |
| T_L | Lead Temperature, 1 mm from Case for 10 Seconds | 260 | $^{\circ}C$ |
| T_J | Junction Temperature Under Bias | +150 | $^{\circ}C$ |
| θ_{JA} | Thermal Resistance SC-88A/SOT-353 (Note 1) SOT-553 | 350 496 | $^{\circ}C/W$ |
| P_D | Power Dissipation in Still Air at 85 $^{\circ}C$ SC-88A/SOT-353 SOT-553 | 186 135 | 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 Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4) | Class IC Class A N/A | V |
| $I_{LATCHUP}$ | Latchup Performance Above V_{CC} and Below GND at 125 $^{\circ}C$ (Note 5) | ± 100 | mA |

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. 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, rated to EIA/JESD22-A114-B.
3. Tested to EIA/JESD22-A115-A, rated to EIA/JESD22-A115-A.
4. Tested to JESD22-C101-A.
5. Tested to EIA/JESD78.

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RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Units |
|---------------------------------|--|-------------|-----------------|-------|
| V _{CC} | DC Supply Voltage (Operating) Data Retention Only | 1.65 1.5 | 5.5 5.5 | V |
| V _{IN} | DC Input Voltage | 0 | 5.5 | V |
| V _{OUT} | DC Output Voltage (SOT-353/SC70-5/SC-88A/SOT-553 Packages) | 0 | 5.5 | V |
| V _{OUT} | DC Output Voltage (SOT-953 Package) | 0 | V _{CC} | V |
| T _A | Operating Temperature Range | -40 | +85 | °C |
| t _r , t _f | Input Rise and Fall Time V _{CC} = 3.0 V ±0.3 V V _{CC} = 5.0 V ±0.5 V | 0 0 | 100 20 | ns/V |

DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Condition | V _{CC} (V) | T _A = 25°C | | | -40°C ≤ T _A ≤ 85°C | | Units |
|------------------|---|---|------------------------|-----------------------|-----------------|----------------------|-------------------------------|----------------------|-------|
| | | | | Min | Typ | Max | Min | Max | |
| V _{IH} | High-Level Input Voltage | | 1.65 to 1.85 | 0.85 V _{CC} | | | 0.85 V _{CC} | | V |
| | | | 2.3 to 5.5 | 0.8 V _{CC} | | | 0.8 V _{CC} | | |
| V _{IL} | Low-Level Input Voltage | | 1.65 to 1.85 | | | 0.15 V _{CC} | | 0.15 V _{CC} | V |
| | | | 2.3 to 5.5 | | | 0.2 V _{CC} | | 0.2 V _{CC} | |
| V _{OH} | High-Level Output Voltage V _{IN} = V _{IL} or V _{IH} | I _{OH} = -100 μA I _{OH} = -3 mA I _{OH} = -4 mA I _{OH} = -6 mA I _{OH} = -8 mA I _{OH} = -12 mA I _{OH} = -16 mA | 1.65 to 5.5 | V _{CC} - 0.1 | V _{CC} | | V _{CC} - 0.1 | | V |
| | | | 1.65 | 1.29 | 1.52 | | 1.29 | | |
| | | | 2.3 | 1.9 | 2.1 | | 1.9 | | |
| | | | 2.7 | 2.2 | 2.4 | | 2.2 | | |
| | | | 3.0 | 2.4 | 2.7 | | 2.4 | | |
| | | | 3.0 | 2.3 | 2.5 | | 2.3 | | |
| | | | 4.5 | 3.8 | 4.0 | | 3.8 | | |
| V _{OL} | Low-Level Output Voltage V _{IN} = V _{IH} or V _{OH} | I _{OL} = 100 μA I _{OL} = 3 mA I _{OL} = 4 mA I _{OL} = 6 mA I _{OL} = 8 mA I _{OL} = 12 mA I _{OL} = 16 mA | 1.65 to 5.5 | | | 0.1 | | 0.1 | V |
| | | | 1.65 | | 0.08 | | 0.24 | | |
| | | | 2.3 | | 0.20 | | 0.3 | | |
| | | | 2.7 | | 0.22 | | 0.4 | | |
| | | | 3.0 | | 0.28 | | 0.4 | | |
| | | | 3.0 | | 0.38 | | 0.55 | | |
| | | | 4.5 | | 0.42 | | 0.55 | | |
| I _{IN} | Input Leakage Current | V _{IN} = 5.5 V or GND | 0 to 5.5 | | | ±0.1 | | ±1.0 | μA |
| I _{OFF} | Power Off Leakage Current (SOT-353/SC70-5/SC-88A/SOT-553 Packages) | V _{IN} = 5.5 V or V _{OUT} = 5.5 V | 0 | | | 1 | | 10 | μA |
| I _{CC} | Quiescent Supply Current | V _{IN} = 5.5 V or GND | 5.5 | | | 1 | | 10 | μA |

AC ELECTRICAL CHARACTERISTICS t_R = t_F = 3.0 ns

| Symbol | Parameter | Condition | V _{CC} (V) | T _A = 25°C | | -40°C ≤ T _A ≤ 85°C | | Units |
|--|---------------------------------------|--|------------------------|-----------------------|------|-------------------------------|------|-------|
| | | | | Min | Max | Min | Max | |
| t _{PLH} t _{PHL} | Propagation Delay (Figure 3 and 4) | R _L = 1 MΩ, C _L = 15 pF | 1.8 ± 0.15 | 1.0 | 11.7 | 1.0 | 12.1 | ns |
| | | R _L = 1 MΩ, C _L = 15 pF | 2.5 ± 0.2 | 0.8 | 6.2 | 0.8 | 6.5 | |
| | | R _L = 1 MΩ, C _L = 15 pF | 3.3 ± 0.3 | 0.5 | 4.5 | 0.5 | 4.8 | |
| | | R _L = 500 Ω, C _L = 50 pF | | 1.0 | 6.0 | 1.0 | 6.5 | |
| | | R _L = 1 MΩ, C _L = 15 pF | 5.0 ± 0.5 | 0.5 | 3.9 | 0.5 | 4.1 | |
| R _L = 500 Ω, C _L = 50 pF | 0.8 | 5.0 | | 0.8 | 5.5 | | | |

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CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Condition | Typical | Units |
|----------|---|--|-----------|-------|
| C_{IN} | Input Capacitance | $V_{CC} = 5.5\text{ V}, V_I = 0\text{ V or }V_{CC}$ | 4.5 | pF |
| C_{PD} | Power Dissipation Capacitance (Note 6) | 10 MHz, $V_{CC} = 3.3\text{ V}, V_I = 0\text{ V or }V_{CC}$ 10 MHz, $V_{CC} = 5.5\text{ V}, V_I = 0\text{ V or }V_{CC}$ | 6.5 10 | pF |

6. 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: $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}$. C_{PD} is used to determine the no-load dynamic power consumption; $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_{in} + I_{CC} \cdot V_{CC}$.

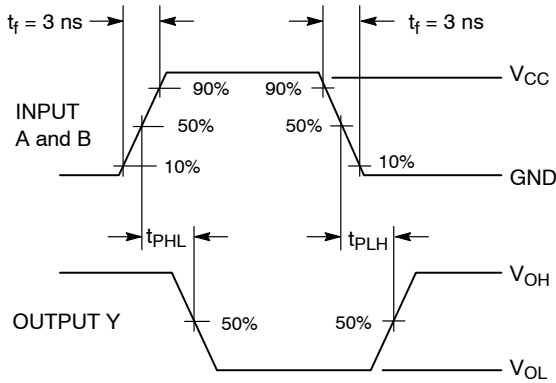
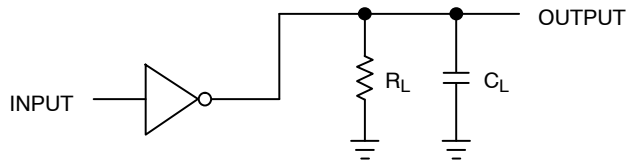


Figure 3. Switching Waveform



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

Figure 4. Test Circuit

ORDERING INFORMATION

| Device | Package | Shipping† |
|------------------|-------------------------------------|--------------------|
| NL17SZU04DFT2G | SC-88A/SOT-353/SC-70-5 (Pb-Free) | 3000 / Tape & Reel |
| NLV17SZU04DFT2G* | SC-88A/SOT-353/SC-70-5 (Pb-Free) | 3000 / Tape & Reel |
| NL17SZU04XV5T2G | SOT-553 (Pb-Free) | 4000 / Tape & Reel |
| NL17SZU04P5T5G | SOT-953 (Pb-Free) | 8000 / Tape & Reel |

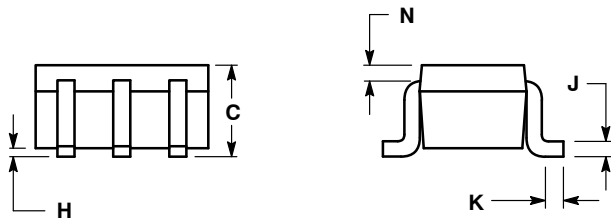
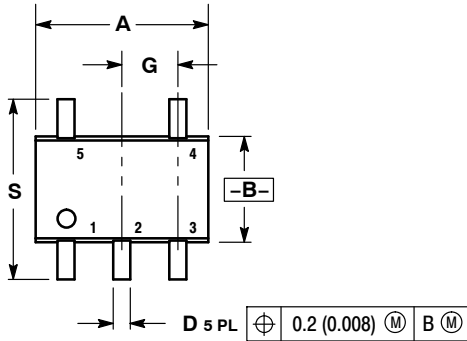
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

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PACKAGE DIMENSIONS

SC-88A (SC-70-5/SOT-353)
CASE 419A-02
ISSUE L

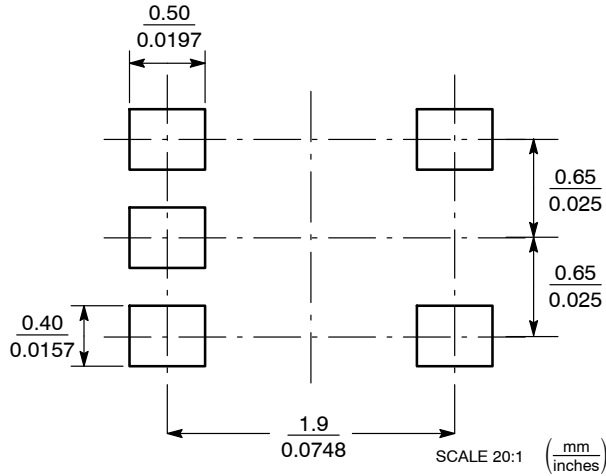


NOTES:

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 |

SOLDER FOOTPRINT*

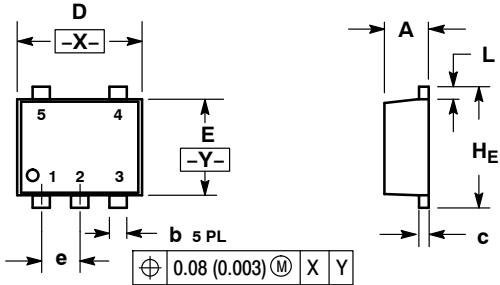


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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PACKAGE DIMENSIONS

SOT-553
XV5 SUFFIX
CASE 463B
ISSUE B

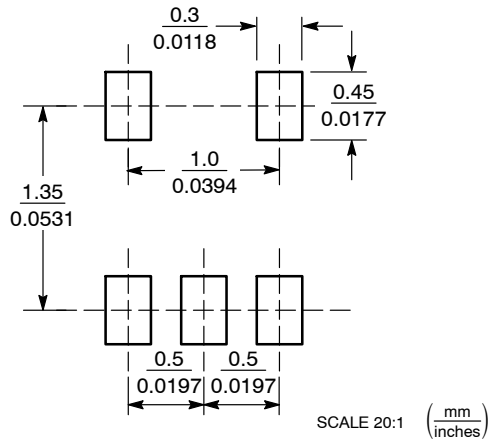


- STYLE 1:
PIN 1. BASE 1
2. EMITTER 1/2
3. BASE 2
4. COLLECTOR 2
5. COLLECTOR 1
- STYLE 2:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. CATHODE
5. CATHODE

- 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 | NOM | MAX | MIN | NOM | MAX |
| A | 0.50 | 0.55 | 0.60 | 0.020 | 0.022 | 0.024 |
| b | 0.17 | 0.22 | 0.27 | 0.007 | 0.009 | 0.011 |
| c | 0.08 | 0.13 | 0.18 | 0.003 | 0.005 | 0.007 |
| D | 1.50 | 1.60 | 1.70 | 0.059 | 0.063 | 0.067 |
| E | 1.10 | 1.20 | 1.30 | 0.043 | 0.047 | 0.051 |
| e | 0.50 BSC | | | 0.020 BSC | | |
| L | 0.10 | 0.20 | 0.30 | 0.004 | 0.008 | 0.012 |
| HE | 1.50 | 1.60 | 1.70 | 0.059 | 0.063 | 0.067 |

SOLDERING FOOTPRINT*

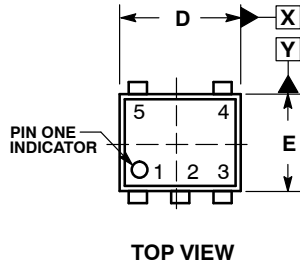


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

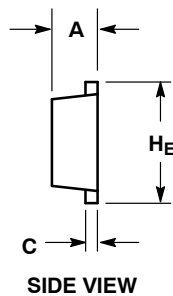
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PACKAGE DIMENSIONS

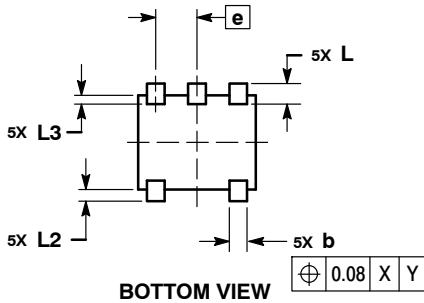
SOT-953
CASE 527AE
ISSUE E



TOP VIEW



SIDE VIEW



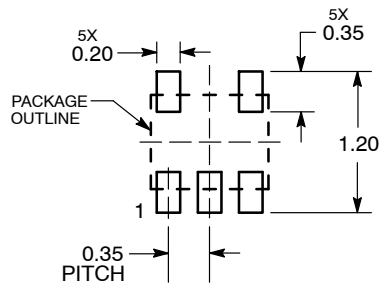
BOTTOM VIEW

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.


| DIM | MILLIMETERS | | |
|-----|-------------|------|------|
| | MIN | NOM | MAX |
| A | 0.34 | 0.37 | 0.40 |
| b | 0.10 | 0.15 | 0.20 |
| C | 0.07 | 0.12 | 0.17 |
| D | 0.95 | 1.00 | 1.05 |
| E | 0.75 | 0.80 | 0.85 |
| e | 0.35 BSC | | |
| He | 0.95 | 1.00 | 1.05 |
| L | 0.175 REF | | |
| L2 | 0.05 | 0.10 | 0.15 |
| L3 | --- | --- | 0.15 |

SOLDERING 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.

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