

# Single Inverter

## NLV17SZ04

The NLV17SZ04 is an inverter in tiny footprint packages.

### Features

- Designed for 1.65 V to 5.5 V  $V_{CC}$  Operation
- 2.4 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
- Source/Sink 24 mA at 3.0 V
- Available in SC-88A, SOT-553 and SOT-953 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

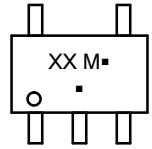


Figure 1. Logic Symbol

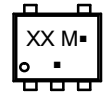


SC-88A  
DF SUFFIX  
CASE 419A

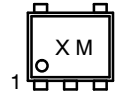
### MARKING DIAGRAMS



SOT-553  
XV5 SUFFIX  
CASE 463B



SOT-953  
P5 SUFFIX  
CASE 527AE



XX = 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, marking and shipping information in the package dimensions section on page 6 of this data sheet.

# NLV17SZ04

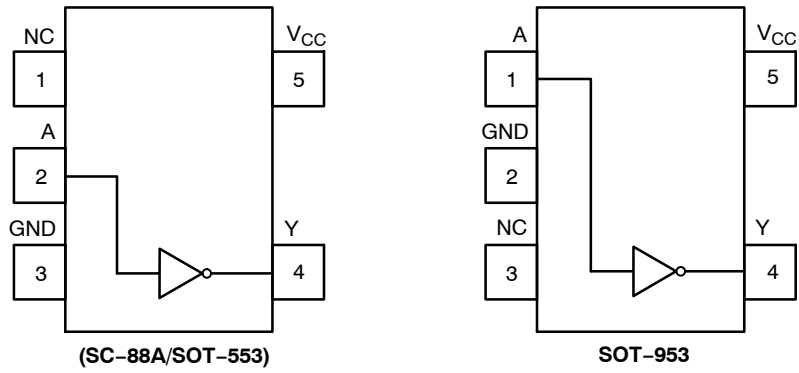


Figure 2. Pinout (Top View)

## PIN ASSIGNMENT (SC-88A/SOT-553)

Pin	Function
1	NC
2	A
3	GND
4	Y
5	V <sub>CC</sub>

## PIN ASSIGNMENT (SOT-953)

Pin	Function
1	A
2	GND
3	NC
4	Y
5	V <sub>CC</sub>

## FUNCTION TABLE

Input	Output
A	Y
L	H
H	L

# NLV17SZ04

## MAXIMUM RATINGS

Symbol	Characteristics	Value	Unit
V <sub>CC</sub>	DC Supply Voltage	-0.5 to +7.0	V
V <sub>IN</sub>	DC Input Voltage	-0.5 to +7.0	V
V <sub>OUT</sub>	DC Output Voltage	Active-Mode (High or Low State) Tri-State Mode (Note 1) Power-Down Mode (V <sub>CC</sub> = 0 V)	-0.5 to V <sub>CC</sub> + 0.5 -0.5 to +7.0 -0.5 to +7.0
	DC Output Voltage	(NL17SZ04P5T5G-L22088 Only)	-0.5 to V <sub>CC</sub> + 0.5
I <sub>IK</sub>	DC Input Diode Current	V <sub>IN</sub> < GND	-50 mA
I <sub>OK</sub>	DC Output Diode Current	V <sub>OUT</sub> < GND	-50 mA
	DC Output Diode Current	(NL17SZ04P5T5G-L22088 Only)	±50
I <sub>OUT</sub>	DC Output Source/Sink Current		±50 mA
I <sub>CC</sub> or I <sub>GND</sub>	DC Supply Current per Supply Pin or Ground 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 secs		260 °C
T <sub>J</sub>	Junction Temperature Under Bias		+150 °C
θ <sub>JA</sub>	Thermal Resistance (Note 2)	SC-88A	377
		SOT-553	324
		SOT-953	254
P <sub>D</sub>	Power Dissipation in Still Air	SC-88A	332
		SOT-553	386
		SOT-953	491
MSL	Moisture Sensitivity		Level 1 -
F <sub>R</sub>	Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in -
V <sub>ESD</sub>	ESD Withstand Voltage (Note 3)	Human Body Model	2000
		Charged Device Model	1000
I <sub>Latchup</sub>	Latchup Performance (Note 4)		± 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 10mm-by-1inch, 2 ounce copper trace no air flow per JESD51-7.
3. HBM tested to ANSI/ESDA/JEDEC JS-001-2017. 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	Characteristics	Min	Max	Unit
V <sub>CC</sub>	Positive DC Supply Voltage	1.65	5.5	V
V <sub>IN</sub>	DC Input Voltage	0	5.5	V
V <sub>OUT</sub>	DC Output Voltage	Active-Mode (High or Low State) Tri-State Mode (Note 1) Power-Down Mode (V <sub>CC</sub> = 0 V)	0 0 0	V <sub>CC</sub> 5.5 5.5
	DC Output Voltage	(NL17SZ04P5T5G-L22088 Only)	0	V <sub>CC</sub>
T <sub>A</sub>	Operating Temperature Range	-55	+125	°C
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Time	V <sub>CC</sub> = 3.0 V to 3.6 V	0	100
		V <sub>CC</sub> = 4.5 V to 5.5 V	0	20

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 <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			-55°C ≤ T <sub>A</sub> ≤ 125°C		Units
				Min	Typ	Max	Min	Max	
V <sub>IH</sub>	High-Level Input Voltage		1.65 to 1.95	0.75 × V <sub>CC</sub>	-	-	0.75 × V <sub>CC</sub>	-	V
			2.3 to 5.5	0.70 × V <sub>CC</sub>	-	-	0.70 × V <sub>CC</sub>	-	
V <sub>IL</sub>	Low-Level Input Voltage		1.65 to 1.95	-	-	0.25 × V <sub>CC</sub>	-	0.25 × V <sub>CC</sub>	V
			2.3 to 5.5	-	-	0.30 × V <sub>CC</sub>	-	0.30 × V <sub>CC</sub>	
V <sub>OH</sub>	High-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	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> = -100 μA	1.65	1.29	1.4	-	1.29	-	
		I <sub>OH</sub> = -4 mA	2.3	1.9	2.1	-	1.9	-	
		I <sub>OH</sub> = -8 mA	2.7	2.2	2.4	-	2.2	-	
		I <sub>OH</sub> = -12 mA	3.0	2.4	2.7	-	2.4	-	
		I <sub>OH</sub> = -16 mA	3.0	2.3	2.5	-	2.3	-	
		I <sub>OH</sub> = -24 mA	4.5	3.8	4.0	-	3.8	-	
		I <sub>OH</sub> = -32 mA							
V <sub>OL</sub>	Low-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	1.65 to 5.5	-	-	0.1	-	0.1	V
		I <sub>OL</sub> = 100 μA	1.65	-	0.08	0.24	-	0.24	
		I <sub>OL</sub> = 4 mA	2.3	-	0.2	0.3	-	0.3	
		I <sub>OL</sub> = 8 mA	2.7	-	0.22	0.4	-	0.4	
		I <sub>OL</sub> = 12 mA	3.0	-	0.28	0.4	-	0.4	
		I <sub>OL</sub> = 16 mA	3.0	-	0.38	0.55	-	0.55	
		I <sub>OL</sub> = 24 mA	4.5	-	0.42	0.55	-	0.55	
		I <sub>OL</sub> = 32 mA							
I <sub>IN</sub>	Input Leakage Current	V <sub>IN</sub> = 5.5 V or GND	1.65 to 5.5	-	-	±0.1	-	±1.0	μA
I <sub>OFF</sub>	Power Off Leakage Current	V <sub>IN</sub> = 5.5 V or V <sub>OUT</sub> = 5.5 V	0	-	-	1.0	-	10	μA
	Power Off Leakage Current (NL17SZ04P5T5G-L22088 Only)	V <sub>IN</sub> = 5.5 V	0	-	-	1.0	-	10	μA
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5	-	-	1.0	-	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.

## AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			-55°C ≤ T <sub>A</sub> ≤ 125°C		Units
				Min	Typ	Max	Min	Max	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, A to Y (Figures 3 and 4)	R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF	1.65 to 1.95	-	5.3	11.4	-	12.0	ns
		R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF	2.3 to 2.7	-	3.5	6.5	-	7.0	
		R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF	3.0 to 3.6	-	2.1	4.5	-	4.7	
		R <sub>L</sub> = 500 Ω, C <sub>L</sub> = 50 pF		-	2.9	5.2	-	5.5	
		R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF	4.5 to 5.5	-	1.8	3.9	-	4.1	
		R <sub>L</sub> = 500 Ω, C <sub>L</sub> = 50 pF		-	2.4	4.3	-	4.5	

## CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Condition	Typical	Units
C <sub>IN</sub>	Input Capacitance	V <sub>CC</sub> = 5.5 V, V <sub>IN</sub> = 0 V or V <sub>CC</sub>	2.5	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>CC</sub> = 5.5 V, V <sub>IN</sub> = 0 V or V <sub>CC</sub>	2.5	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Note 5)	10 MHz, V <sub>CC</sub> = 3.3 V, V <sub>IN</sub> = 0 V or V <sub>CC</sub>	9	pF
		10 MHz, V <sub>CC</sub> = 5.5 V, V <sub>IN</sub> = 0 V or V <sub>CC</sub>	11	

5. 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>.

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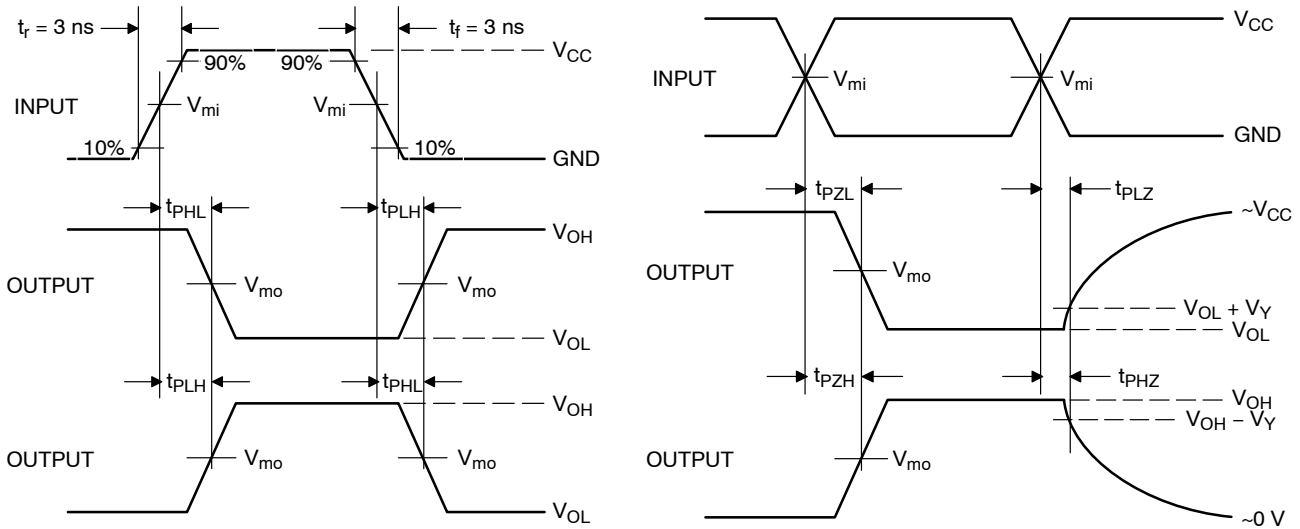


$C_L$  includes probe and jig capacitance  
 $R_T$  is  $Z_{OUT}$  of pulse generator (typically 50  $\Omega$ )  
 $f = 1$  MHz

**Figure 3. Test Circuit**

Test	Switch Position	$C_L$ , pF	$R_L$ , $\Omega$	$R_1$ , $\Omega$
$t_{PLH} / t_{PHL}$	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 4. 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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## DEVICE ORDERING INFORMATION

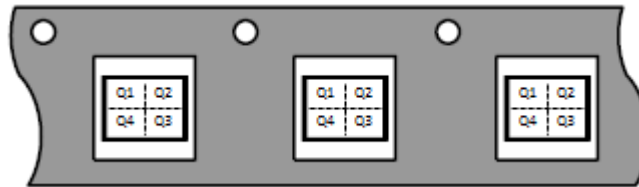
Device	Packages	Specific Device Code	Pin 1 Orientation (See below)	Shipping†
NL17SZ04DFT2G-L22038	SC-88A	L5	Q4	3000 / Tape & Reel
NLV17SZ04DFT2G*	SC-88A	L5	Q4	3000 / Tape & Reel
NL17SZ04XV5T2G-L22087	SOT-553	L5	Q4	4000 / Tape & Reel
NL17SZ04P5T5G-L22088	SOT-953	5 (Rotated 90° CW)	Q2	8000 / Tape & Reel

†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.

### Pin 1 Orientation in Tape and Reel

Direction of Feed



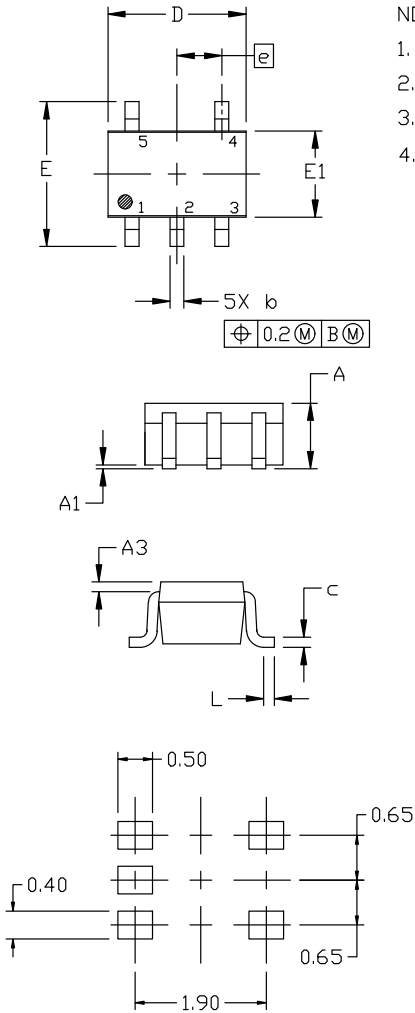
# NLV17SZ04

## PACKAGE DIMENSIONS

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

**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. 419A-01 OBSOLETE. NEW STANDARD 419A-02
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.1016MM PER SIDE.



DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.80	0.95	1.10
A1	---	---	0.10
A3	0.20 REF		
b	0.10	0.20	0.30
c	0.10	---	0.25
D	1.80	2.00	2.20
E	2.00	2.10	2.20
E1	1.15	1.25	1.35
e	0.65 BSC		
L	0.10	0.15	0.30

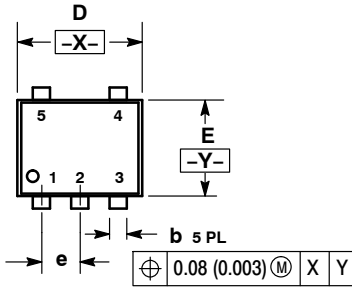
**RECOMMENDED  
MOUNTING FOOTPRINT**

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

# NLV17SZ04

## PACKAGE DIMENSIONS

### SOT-553, 5 LEAD CASE 463B ISSUE C

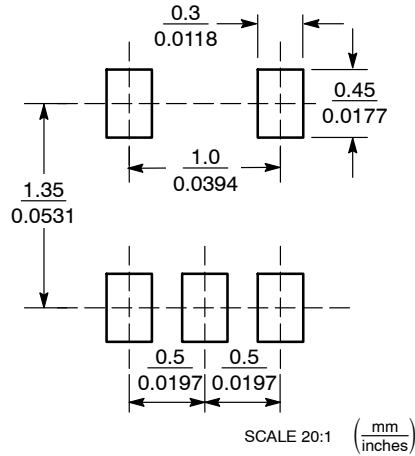


NOTES:

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	1.55	1.60	1.65	0.061	0.063	0.065
E	1.15	1.20	1.25	0.045	0.047	0.049
e	0.50 BSC			0.020 BSC		
L	0.10	0.20	0.30	0.004	0.008	0.012
H <sub>E</sub>	1.55	1.60	1.65	0.061	0.063	0.065

### SOLDERING FOOTPRINT\*



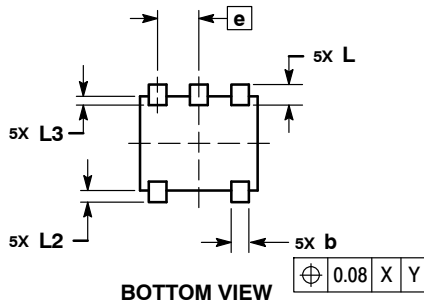
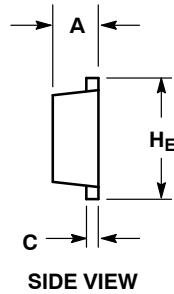
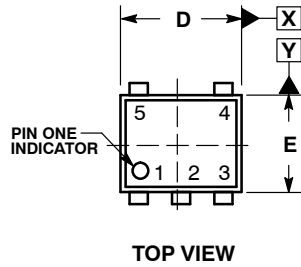
\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



# NLV17SZ04

## PACKAGE DIMENSIONS

**SOT-953**  
CASE 527AE  
ISSUE E

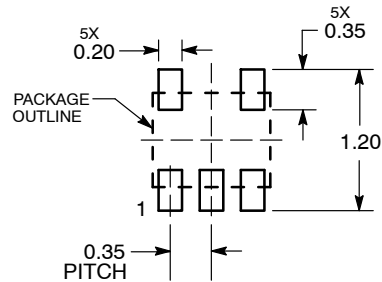


**NOTES:**

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 **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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