## Onsemi

Single Inverter			MARKING
NL17SZ04			
The NL17SZ04 is an inverter in tiny footprint packages.	<b>N</b>	SC-88A DF SUFFIX CASE 419A	
<ul> <li>Features</li> <li>Designed for 1.65 V to 5.5 V V<sub>CC</sub> Operation</li> <li>2.4 ns t<sub>PD</sub> at V<sub>CC</sub> = 5 V (typ)</li> <li>Inputs/Outputs Overvoltage Tolerant up to 5.5 V</li> <li>I<sub>OFF</sub> Supports Partial Power Down Protection</li> <li>Source/Sink 24 mA at 3.0 V</li> </ul>	-	SC-74A DBV SUFFIX CASE 318BQ	
<ul> <li>Available in SC-88A, SC-74A, SOT-553, SOT-953 and UDFN6 Packages</li> <li>Chip Complexity &lt; 100 FETs</li> <li>NLV Prefix for Automotive and Other Applications Requiring</li> </ul>	****	SOT-553 XV5 SUFFIX CASE 463B	XX M•
<ul> <li>Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable</li> <li>These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant</li> </ul>	and the second s	SOT-953 P5 SUFFIX CASE 527AE	
A Y		UDFN6 1.45 x 1.0 CASE 517AQ	● ×M
Figure 1. Logic Symbol	Ŷ	UDFN6 1.0 x 1.0 CASE 517BX	1 •
		XX = Specific Dev M = Date Code*	vice Code

= Pb-Free Package

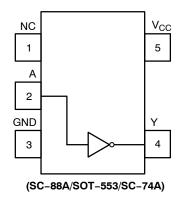
•

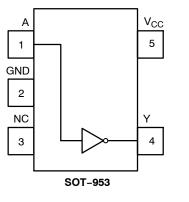
(Note: Microdot may be in either location)

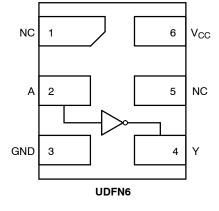
\*Date Code orientation and/or position may vary depending upon manufacturing location.

### **ORDERING INFORMATION**

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







PIN ASSIGNMENT

(SC-88A/SOT-553/SC-74A)

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

#### PIN ASSIGNMENT (SOT-953)

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

Figure 2. Pinout (Top View)

#### **PIN ASSIGNMENT (UDFN)**

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

#### FUNCTION TABLE

Input	Output
А	Y
L	Н
Н	L

#### **MAXIMUM RATINGS**

Symbol	Chara	cteristics	Value	Unit
V <sub>CC</sub>	DC Supply Voltage	(NLV)	-0.5 to +7.0 -0.5 to +6.5	V
V <sub>IN</sub>	DC Input Voltage	(NLV)	-0.5 to +7.0 -0.5 to +6.5	V
V <sub>OUT</sub>	DC Output Voltage (NLV)	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	V
	DC Output Voltage	(NL17SZ04P5T5G-L22088 Only)	–0.5 to V <sub>CC</sub> + 0.5	
	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 +6.5 -0.5 to +6.5	
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 0	Ground Pin	±100	mA
T <sub>STG</sub>	Storage Temperature Range		-65 to +150	°C
ΤL	Lead Temperature, 1 mm from Case for	or 10 secs	260	°C
TJ	Junction Temperature Under Bias		+150	°C
$\theta_{JA}$	Thermal Resistance (Note 2)	SC-88A SC-74A SOT-553 SOT-953 UDFN6	377 320 324 254 154	°C/W
PD	Power Dissipation in Still Air	SC-88A SC-74A SOT-553 SOT-953 UDFN6	332 390 386 491 812	mW
MSL	Moisture Sensitivity		Level 1	-
F <sub>R</sub>	Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in	-
$V_{\text{ESD}}$	ESD Withstand Voltage (Note 3)	Human Body Model Charged Device Model	2000 1000	V
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.
Applicable to devices with outputs that may be tri-stated.
Measured with minimum pad spacing on an FR4 board, using 10mm-by-1inch, 2 ounce copper trace no air flow per JESD51-7.
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	Cha	Characteristics			
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	V
	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 (NLV)	V <sub>CC</sub> = 3.0 V to 3.6 V V <sub>CC</sub> = 4.5 V to 5.5 V	0 0	100 20	ns/V
	Input Rise and Fall Time	$\begin{array}{l} V_{CC} = 1.65 \; V \; to \; 1.95 \; V \\ V_{CC} = 2.3 \; V \; to \; 2.7 \; V \\ V_{CC} = 3.0 \; V \; to \; 3.6 \; V \\ V_{CC} = 4.5 \; V \; to \; 5.5 \; V \end{array}$	0 0 0 0	20 20 10 5	

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.

#### DC ELECTRICAL CHARACTERISTICS

				Т	A = 25°	С	–55°C ≤ T	A ≤ 125°C	
Symbol	Parameter	Condition	V <sub>CC</sub> (V)	Min	Тур	Max	Min	Max	Units
V <sub>IH</sub>	High-Level Input Voltage (NLV and		1.65 to 1.95	$0.75 \times V_{CC}$	_	-	$0.75 \times V_{CC}$	-	V
	NL17SZ04P5T5G- L22088)		2.3 to 5.5	$0.70 \times V_{CC}$	-	-	$0.70 \times V_{CC}$	-	
	High-Level Input		1.65 to 1.95	$0.65 \times V_{CC}$	-	-	$0.65 \times V_{CC}$	-	V
	Voltage		2.3 to 5.5	$0.70 \times V_{CC}$	-	-	$0.70 \times V_{CC}$	-	
V <sub>IL</sub>	Low-Level Input Voltage (NLV and		1.65 to 1.95	-	-	$0.25 \times V_{CC}$	-	$0.25 \times V_{CC}$	V
	NL17SZ04P5T5G- L22088)		2.3 to 5.5	-	-	$0.30 \times V_{CC}$	-	$0.30 \times V_{CC}$	
	Low-Level Input		1.65 to 1.95	-	-	$0.35 \times V_{CC}$	-	$0.35 \times V_{CC}$	V
	Voltage		2.3 to 5.5	-	-	$0.30 \times V_{CC}$	-	$0.30 \times V_{CC}$	
V <sub>OH</sub>	High-Level Output Voltage	$ \begin{array}{l} V_{IN} = V_{IH} \text{ or } V_{IL} \\ I_{OH} = -100 \ \mu\text{A} \\ I_{OH} = -4 \ \text{mA} \\ I_{OH} = -8 \ \text{mA} \\ I_{OH} = -12 \ \text{mA} \\ I_{OH} = -16 \ \text{mA} \\ I_{OH} = -24 \ \text{mA} \\ I_{OH} = -32 \ \text{mA} \end{array} $	1.65 to 5.5 1.65 2.3 2.7 3.0 3.0 4.5	V <sub>CC</sub> - 0.1 1.29 1.9 2.2 2.4 2.3 3.8	V <sub>CC</sub> 1.4 2.1 2.4 2.7 2.5 4.0		V <sub>CC</sub> - 0.1 1.29 1.9 2.2 2.4 2.3 3.8		V
V <sub>OL</sub>	Low-Level Output Voltage		1.65 to 5.5 1.65 2.3 2.7 3.0 3.0 4.5	- - - - -	- 0.08 0.2 0.22 0.28 0.38 0.42	0.1 0.24 0.3 0.4 0.4 0.55 0.55	- - - - -	0.1 0.24 0.3 0.4 0.4 0.55 0.55	V
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

#### DC ELECTRICAL CHARACTERISTICS (continued)

				T <sub>A</sub> = 25°C		–55°C ≤ T <sub>A</sub> ≤ 125°C			
Symbol	Parameter	Condition	V <sub>CC</sub> (V)	Min	Тур	Max	Min	Max	Units
I <sub>OFF</sub>	Power Off Leakage Current	$V_{IN}$ = 5.5 V or $V_{OUT}$ = 5.5 V	0	-	-	1.0	-	10	μΑ
	Power Off Leakage Current (NL17SZ04P5T5G- L22088 Only)	V <sub>IN</sub> = 5.5 V	0	-	-	1.0	-	10	μΑ
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5	-	-	1.0	-	10	μΑ

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.

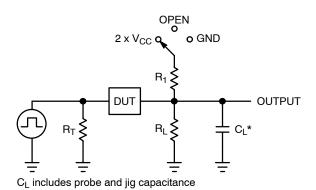
#### AC ELECTRICAL CHARACTERISTICS

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

#### **CAPACITIVE CHARACTERISTICS**

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

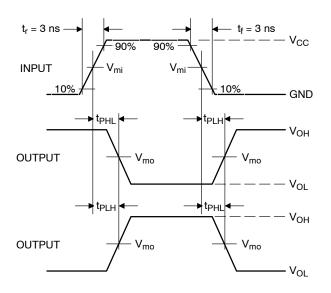
5.  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation:  $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}$ .  $C_{PD}$  is used to determine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

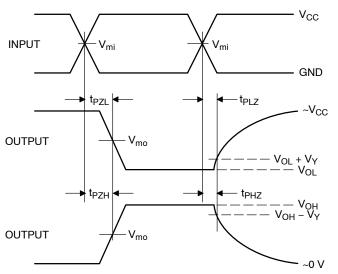


Test	Switch Position	C <sub>L</sub> , pF	$R_L, \Omega$	<b>R</b> <sub>1</sub> , Ω			
t <sub>PLH</sub> / t <sub>PHL</sub>	Open	See AC Character	istics Tal	ole			
t <sub>PLZ</sub> / t <sub>PZL</sub>	$2 \times V_{CC}$	50	500	500			
t <sub>PHZ</sub> / t <sub>PZH</sub>	GND	50	500	500			
X = Don't Care							

 $R_T$  is  $Z_{OUT}$  of pulse generator (typically 50  $\Omega$ ) f = 1 MHz







#### Figure 4. Switching Waveforms

		V <sub>mo</sub> , V		
V <sub>CC</sub> , V	V <sub>mi</sub> , V	t <sub>PLH</sub> , t <sub>PHL</sub>	t <sub>PZL</sub> , t <sub>PLZ</sub> , t <sub>PZH</sub> , t <sub>PHZ</sub>	V <sub>Y</sub> , V
1.65 to 1.95	V <sub>CC</sub> /2	V <sub>CC</sub> /2	V <sub>CC</sub> /2	0.15
2.3 to 2.7	V <sub>CC</sub> /2	V <sub>CC</sub> /2	V <sub>CC</sub> /2	0.15
3.0 to 3.6	V <sub>CC</sub> /2	V <sub>CC</sub> /2	V <sub>CC</sub> /2	0.3
4.5 to 5.5	V <sub>CC</sub> /2	V <sub>CC</sub> /2	V <sub>CC</sub> /2	0.3

#### **DEVICE ORDERING INFORMATION**

Device	Packages	Specific Device Code	Pin 1 Orientation (See below)	Shipping <sup>†</sup>
NL17SZ04DFT2G	SC-88A	L5	Q4	3000 / Tape & Reel
NL17SZ04DFT2G-L22038**	SC-88A	L5	Q4	3000 / Tape & Reel
NLV17SZ04DFT2G	SC-88A	L5	Q4	3000 / Tape & Reel
NL17SZ04DBVT1G	SC-74A	AD	Q4	3000 / Tape & Reel
NL17SZ04XV5T2G	SOT-553	L5	Q4	4000 / Tape & Reel
NL17SZ04XV5T2G-L22087**	SOT-553	L5	Q4	4000 / Tape & Reel
NL17SZ04P5T5G	SOT-953	5 (Rotated 90° CW)	Q2	8000 / Tape & Reel
NL17SZ04P5T5G-L22088	SOT-953	5 (Rotated 90° CW)	Q2	8000 / Tape & Reel
NL17SZ04MU1TCG (In Development)	UDFN6, 1.45 x 1.0, 0.5P	TBD	Q4	3000 / Tape & Reel
NL17SZ04MU3TCG (In Development)	UDFN6, 1.0 x 1.0, 0.35P	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.
 \*\* Please refer to NLV specifications for this device.

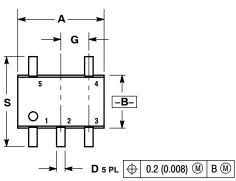
#### Pin 1 Orientation in Tape and Reel

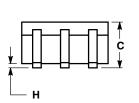
# **Direction of Feed**

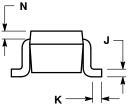


#### PACKAGE DIMENSIONS

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



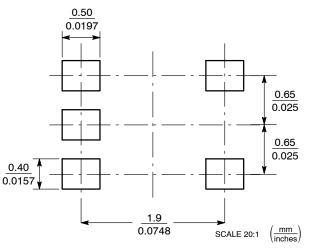




NOTES: 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982. 2. CONTROLLING DIMENSION: INCH. 3. 419A-01 OBSOLETE. NEW STANDARD 419A-02. 4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

	INCHES		MILLIMETERS		
DIM	MIN	MAX	MIN	MAX	
Α	0.071	0.087	1.80	2.20	
В	0.045	0.053	1.15	1.35	
С	0.031	0.043	0.80	1.10	
D	0.004	0.012	0.10	0.30	
G	0.026 BSC		0.65 BSC		
Η		0.004		0.10	
ſ	0.004	0.010	0.10	0.25	
Κ	0.004	0.012	0.10	0.30	
Ν	0.008 REF		0.20	REF	
s	0.079	0.087	2.00	2.20	

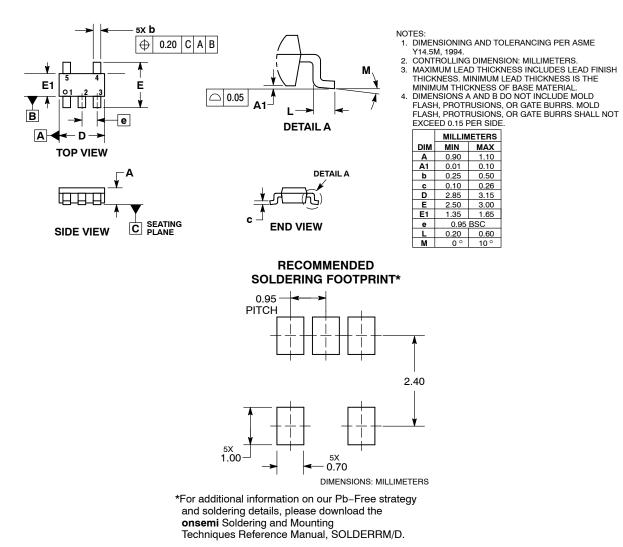
**SOLDER FOOTPRINT\*** 



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

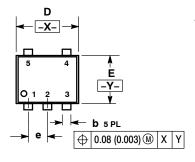
#### PACKAGE DIMENSIONS

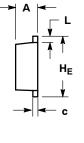
#### SC-74A CASE 318BQ ISSUE B



#### PACKAGE DIMENSIONS

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



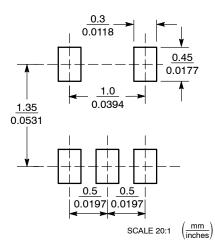


NOTES: 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982. 2. CONTROLLING DIMENSION: MILLIMETERS 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS, MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS, DAOC MEEDING

THICKNESS OF BASE MATERIAL.	

	MILLIMETERS			INCHES		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
Α	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
С	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
е		0.50 BSC			0.020 BSC	)
L	0.10	0.20	0.30	0.004	0.008	0.012
HE	1.55	1.60	1.65	0.061	0.063	0.065

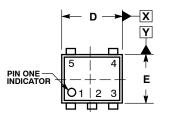
#### **SOLDERING FOOTPRINT\***



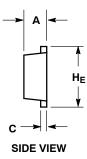
\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

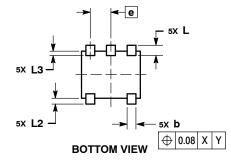
#### PACKAGE DIMENSIONS

SOT-953 CASE 527AE ISSUE E



TOP VIEW

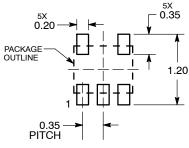




- NOTES:
   1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
   2. CONTROLLING DIMENSION: MILLIMETERS
   3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
   4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE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

	MILLIMETERS				
DIM	MIN	NOM	MAX		
Α	0.34	0.37	0.40		
b	0.10	0.15	0.20		
С	0.07	0.12	0.17		
D	0.95	1.00	1.05		
Е	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\***

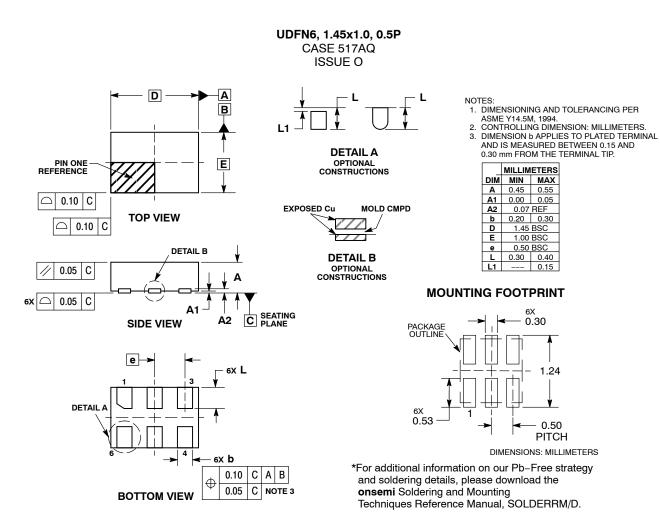


DIMENSIONS: MILLIMETERS

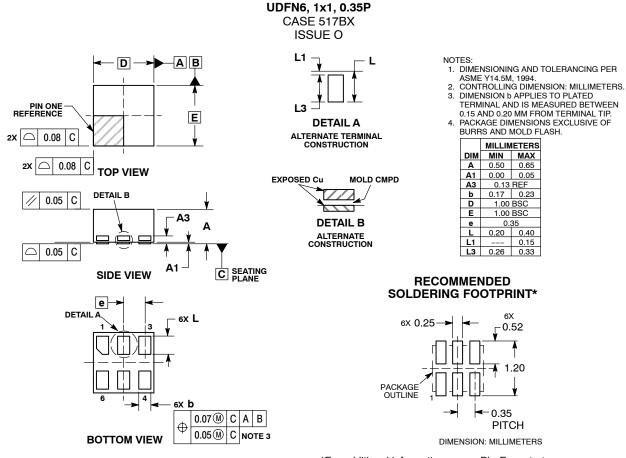
\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

www.onsemi.com 11

#### PACKAGE DIMENSIONS



#### PACKAGE DIMENSIONS



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

onsemi. OnSemi, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries. LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries. onsemi owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of onsemi's product/patent coverage may be accessed at <u>www.onsemi.com/site/pdf/Patent-Marking.pdf</u>. onsemi reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and onsemi makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and calcular performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems. or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

#### PUBLICATION ORDERING INFORMATION

#### LITERATURE FULFILLMENT:

#### TECHNICAL SUPPORT

onsemi Website: www.onsemi.com

Email Requests to: orderlit@onsemi.com

North American Technical Support: Voice Mail: 1 800–282–9855 Toll Free USA/Canada Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support: Phone: 00421 33 790 2910 For additional information, please contact your local Sales Representative

٥