

# Single Inverter

## NL17SG04

The NL17SG04 MiniGate™ is an advanced high-speed CMOS Inverter in ultra-small footprint.

The NL17SG04 input structures provides protection when voltages up to 3.6 V are applied.

### Features

- Designed for 0.9 V to 3.6 V  $V_{CC}$  Operation
- 2.3 ns (Typ) at  $V_{CC} = 3.0$  V,  $C_L = 15$  pF
- Inputs/Outputs Over-Voltage Tolerant up to 3.6 V
- $I_{OFF}$  Supports Partial Power Down Protection
- Available in SC-88A, SOT-953 and UDFN Packages
- -Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen-Free/BFR-Free and RoHS-Compliant

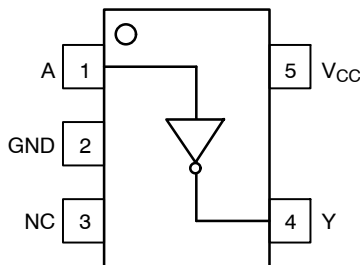


Figure 1. SOT-953  
(Top Thru View)

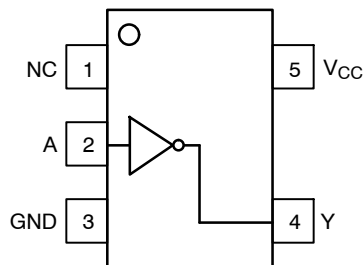


Figure 2. SC-88A  
(Top View)

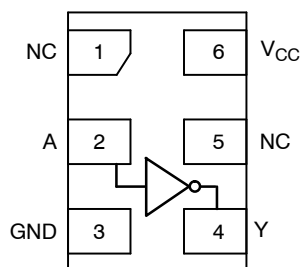


Figure 3. UDFN  
(Top View)

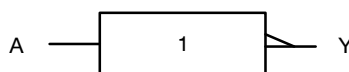
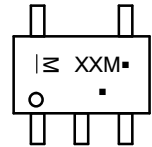


Figure 4. Logic Symbol

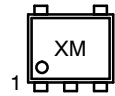
### MARKING DIAGRAMS



SC-88A  
DF SUFFIX  
CASE 419A



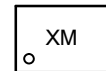
SOT-953  
CASE 527AE



UDFN6  
1.0 x 1.0  
CASE 517BX



UDFN6  
1.45 x 1.0  
CASE 517AQ



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.

### PIN ASSIGNMENT

	SOT-953	SC-88A	UDFN6
1	A	NC	NC
2	GND	A	A
3	NC	GND	GND
4	Y	Y	Y
5	$V_{CC}$	$V_{CC}$	NC
6			$V_{CC}$

### FUNCTION TABLE

A Input	Y Output
L	H
H	L

### ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

# NL17SG04

**Table 1. MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_{CC}$	DC Supply Voltage	-0.5 to +4.3	V
$V_{IN}$	DC Input Voltage	-0.5 to +4.3	V
$V_{OUT}$	DC Output Voltage Active-Mode (High or Low State) Tri-State Mode (Note 1) Power-Down Mode ( $V_{CC} = 0$ V)	-0.5 to $V_{CC} + 0.5$ -0.5 to +4.3 -0.5 to +4.3	V
$I_{IK}$	DC Input Diode Current $V_{IN} < GND$	-20	mA
$I_{OK}$	DC Output Diode Current $V_{OUT} < GND$	-20	mA
$I_{OUT}$	DC Output Source/Sink Current	$\pm 20$	mA
$I_{CC}$ or $I_{GND}$	DC Supply Current Per Supply Pin or Ground Pin	$\pm 20$	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	$^{\circ}C$
$\theta_{JA}$	Thermal Resistance (Note 2)	SC-88A SOT-953 UDFN6	377 254 154 $^{\circ}C/W$
$P_D$	Power Dissipation in Still Air at 85 $^{\circ}C$	SC-88A SOT-953 UDFN6	332 491 812 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 (Note 3) Human Body Model Charged Device Model	2000 1000	V
$I_{LATCHUP}$	Latchup Performance (Note 4)	$\pm 100$	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 10 mm – by – 1inch, 2 ounce copper trace no air flow per JESD51-7.
3. HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.
4. Tested to EIA/JESD78 Class II.

**Table 2. RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	Positive DC Supply Voltage	0.9	3.6	V
$V_{IN}$	Digital Input Voltage	0	3.6	V
$V_{OUT}$	Output Voltage Active Mode (High or Low State) Tri-State Mode (Note 1) Power Down Mode ( $V_{CC} = 0$ V)	0 0 0	$V_{CC}$ 3.6 3.6	V
$T_A$	Operating Free-Air Temperature	-55	+125	$^{\circ}C$
$t_r, t_f$	Input Transition Rise or Fall Rate $V_{CC} = 3.3$ V $\pm$ 0.3 V	0	10	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.

# NL17SG04

**Table 3. DC ELECTRICAL CHARACTERISTICS**

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> = -55°C to +125°C		Unit
				Min	Typ	Max	Min	Max	
V <sub>IH</sub>	High-Level Input Voltage		0.9	-	V <sub>CC</sub>	-	-	-	V
			1.1 to 1.3	0.7 x V <sub>CC</sub>	-	-	0.7 x V <sub>CC</sub>	-	
			1.4 to 1.6	0.65 x V <sub>CC</sub>	-	-	0.65 x V <sub>CC</sub>	-	
			1.65 to 1.95	0.65 x V <sub>CC</sub>	-	-	0.65 x V <sub>CC</sub>	-	
			2.3 to 2.7	1.7	-	-	1.7	-	
			3.0 to 3.6	2.0	-	-	2.0	-	
V <sub>IL</sub>	Low-Level Input Voltage		0.9	-	GND	-	-	-	V
			1.1 to 1.3	-	-	0.3 x V <sub>CC</sub>	-	0.3 x V <sub>CC</sub>	
			1.4 to 1.6	-	-	0.35 x V <sub>CC</sub>	-	0.35 x V <sub>CC</sub>	
			1.65 to 1.95	-	-	0.35 x V <sub>CC</sub>	-	0.35 x V <sub>CC</sub>	
			2.3 to 2.7	-	-	0.7	-	0.7	
			3.0 to 3.6	-	-	0.8	-	0.8	
V <sub>OH</sub>	High-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>							V
		I <sub>OH</sub> = -20 μA	0.9	-	0.75	-	-	-	
		I <sub>OH</sub> = -0.3 mA	1.1 to 1.3	0.75 x V <sub>CC</sub>	-	-	0.75 x V <sub>CC</sub>	-	
		I <sub>OH</sub> = -1.7 mA	1.4 to 1.6	0.75 x V <sub>CC</sub>	-	-	0.75 x V <sub>CC</sub>	-	
		I <sub>OH</sub> = -3.0 mA	1.65 to 1.95	V <sub>CC</sub> - 0.45	-	-	V <sub>CC</sub> - 0.45	-	
		I <sub>OH</sub> = -4.0 mA	2.3 to 2.7	2.0	-	-	2.0	-	
V <sub>OL</sub>	Low-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>							V
		I <sub>OL</sub> = 20 μA	0.9	-	0.1	-	-	-	
		I <sub>OL</sub> = 0.3 mA	1.1 to 1.3	-	-	0.25 x V <sub>CC</sub>	-	0.25 x V <sub>CC</sub>	
		I <sub>OL</sub> = 1.7 mA	1.4 to 1.6	-	-	0.25 x V <sub>CC</sub>	-	0.25 x V <sub>CC</sub>	
		I <sub>OL</sub> = 3.0 mA	1.65 to 1.95	-	-	0.45	-	0.45	
		I <sub>OL</sub> = 4.0 mA	2.3 to 2.7	-	-	0.4	-	0.4	
I <sub>IN</sub>	Input Leakage Current	V <sub>IN</sub> = 0 V to 3.6 V	0.9 to 3.6	-	-	±0.1	-	±1.0	μA
I <sub>OFF</sub>	Power Off Leakage Current	V <sub>IN</sub> = 0 V to 3.6 V; V <sub>OUT</sub> = 0 V to 3.6 V	0	-	-	1.0	-	10.0	μA
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	0.9 to 3.6	-	-	1.0	-	10.0	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.

# NL17SG04

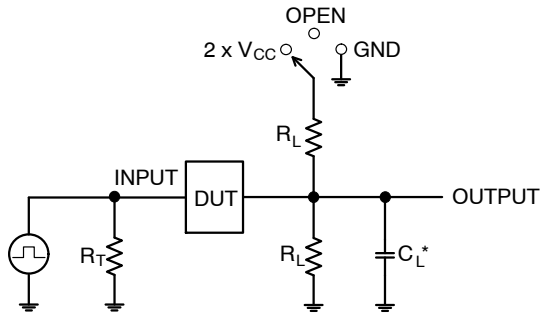
## AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25° C			T <sub>A</sub> = -55°C to +125°C		Unit
				Min	Typ	Max	Min	Max	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, A to Y	C <sub>L</sub> = 10 pF, R <sub>L</sub> = 1 MΩ	0.9	-	39.8	-	-	-	ns
			1.1 to 1.3	-	8.7	21.9	-	25.3	
			1.4 to 1.6	-	4.9	8.5	-	10.0	
			1.65 to 1.95	-	3.8	6.2	-	6.7	
			2.3 to 2.7	-	2.6	3.9	-	4.4	
			3.0 to 3.6	-	2.1	3.1	-	3.7	
		C <sub>L</sub> = 15 pF, R <sub>L</sub> = 1 MΩ	0.9	-	40.9	-	-	-	ns
			1.1 to 1.3	-	8.9	22.6	-	26.1	
			1.4 to 1.6	-	5.4	9.3	-	11.2	
			1.65 to 1.95	-	4.2	6.9	-	7.1	
			2.3 to 2.7	-	2.8	4.4	-	5.0	
			3.0 to 3.6	-	2.3	3.4	-	3.9	
		C <sub>L</sub> = 30 pF, R <sub>L</sub> = 1 MΩ	0.9	-	44.5	-	-	-	ns
			1.1 to 1.3	-	9.5	24.6	-	28.3	
			1.4 to 1.6	-	7.4	13.1	-	15.9	
			1.65 to 1.95	-	5.6	9.2	-	9.6	
			2.3 to 2.7	-	3.7	5.7	-	6.1	
			3.0 to 3.6	-	2.9	4.4	-	4.8	
C <sub>IN</sub>	Input Capacitance		0 to 3.6		3	-	-	pF	
C <sub>PD</sub>	Power Dissipation Capacitance (Note 5)	f = 10 MHz	0.9 to 3.6	-	4	-	-	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.

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>.

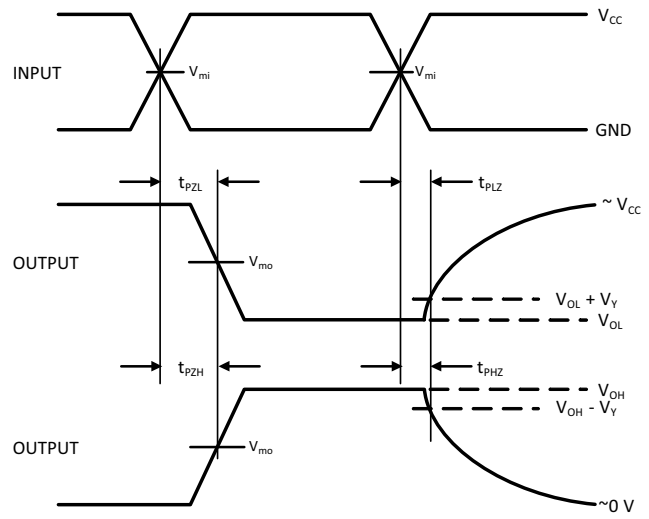
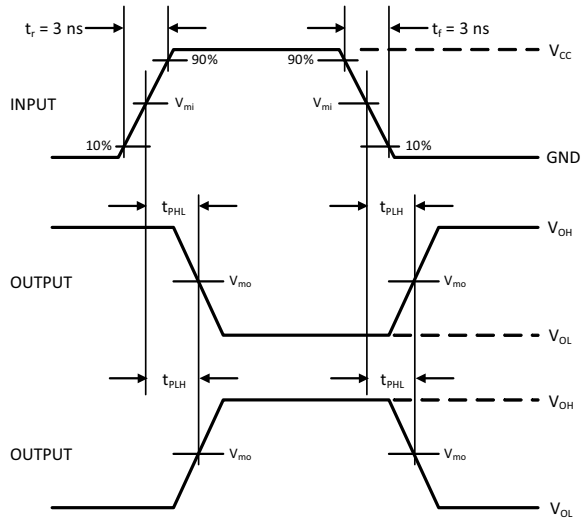
# NL17SG04



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

**Figure 5. Test Circuit**

Test	Switch Position
$t_{PLH} / t_{PHL}$	Open
$t_{PLZ} / t_{PZL}$	$2 \times V_{CC}$
$t_{PHZ} / t_{PZH}$	GND



**Figure 6. Switching Waveforms**

$V_{CC}, V$	$V_{mi}, V$	$V_{mo}, V$	$V_Y, V$
0.9	$V_{CC}/2$	$V_{CC}/2$	0.1
1.1 to 1.3	$V_{CC}/2$	$V_{CC}/2$	0.1
1.4 to 1.6	$V_{CC}/2$	$V_{CC}/2$	0.1
1.65 to 1.95	$V_{CC}/2$	$V_{CC}/2$	0.15
2.3 to 2.7	$V_{CC}/2$	$V_{CC}/2$	0.15
3.0 to 3.6	1.5	1.5	0.3

# NL17SG04

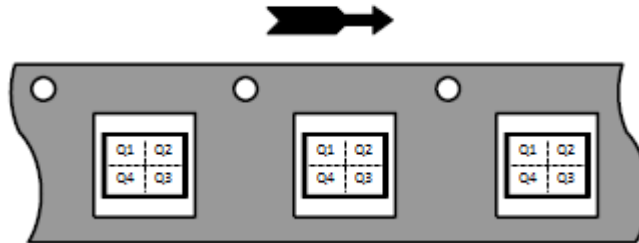
## ORDERING INFORMATION

Device	Marking	Pin 1 Orientation (See below)	Package	Shipping†
NL17SG04DFT2G	AP	Q4	SC-88A	3000 / Tape & Reel
NL17SG04P5T5G	V	Q2	SOT-953	8000 / Tape & Reel
NL17SG04MU1TCG	4	Q4	UDFN6 1.45 x 1.0	3000 / Tape & Reel
NL17SG04MU3TCG	TBD	Q4	UDFN6 1.0 x 1.0	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.

\*-Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.

### PIN 1 ORIENTATION IN TAPE AND REEL Direction of Feed



# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 2:1

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

DATE 11 APR 2023



### 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, SOLDERM/D.

### 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

### GENERIC MARKING DIAGRAM\*



\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

XXX = Specific Device Code

M = Date Code

▪ = Pb-Free Package

(Note: Microdot may be in either location)

#### STYLE 1:

1. BASE
2. EMITTER
3. BASE
4. COLLECTOR
5. COLLECTOR

#### STYLE 2:

1. ANODE
2. EMITTER
3. BASE
4. COLLECTOR
5. CATHODE

#### STYLE 3:

1. ANODE 1
2. N/C
3. ANODE 2
4. CATHODE 2
5. CATHODE 1

#### STYLE 4:

1. SOURCE 1
2. DRAIN 1/2
3. SOURCE 1
4. GATE 1
5. GATE 2

#### STYLE 5:

1. CATHODE
2. COMMON ANODE
3. CATHODE 2
4. CATHODE 3
5. CATHODE 4

#### STYLE 6:

1. EMITTER 2
2. BASE 2
3. EMITTER 1
4. COLLECTOR
5. COLLECTOR 2/BASE 1

#### STYLE 7:

1. BASE
2. EMITTER
3. BASE
4. COLLECTOR
5. COLLECTOR

#### STYLE 8:

1. CATHODE
2. COLLECTOR
3. N/C
4. BASE
5. EMITTER

#### STYLE 9:

1. ANODE
2. CATHODE
3. ANODE
4. ANODE
5. ANODE

Note: Please refer to datasheet for style callout. If style type is not called out in the datasheet refer to the device datasheet pinout or pin assignment.

<b>DOCUMENT NUMBER:</b>	<b>98ASB42984B</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>SC-88A (SC-70-5/SOT-353)</b>	<b>PAGE 1 OF 1</b>

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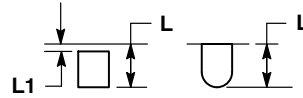
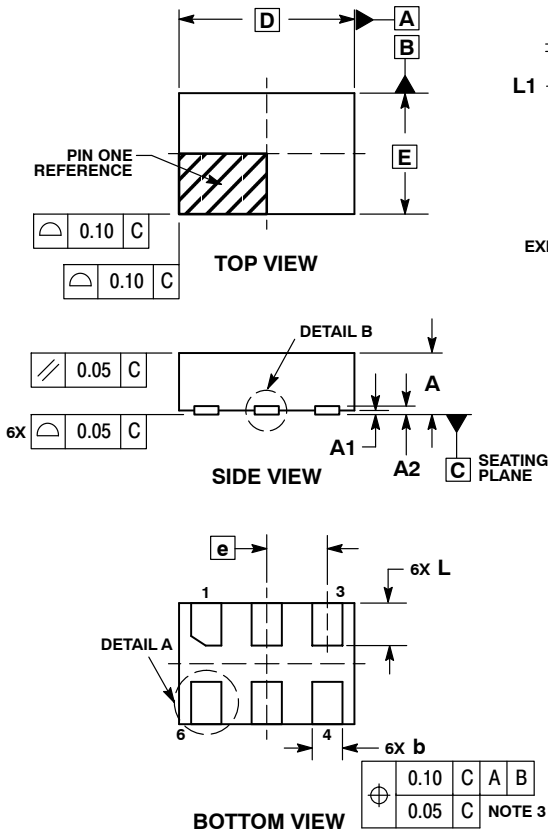
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



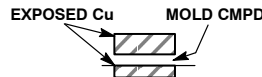
SCALE 4:1

UDFN6, 1.45x1.0, 0.5P  
CASE 517AQ  
ISSUE O

DATE 15 MAY 2008



**DETAIL A**  
OPTIONAL  
CONSTRUCTIONS



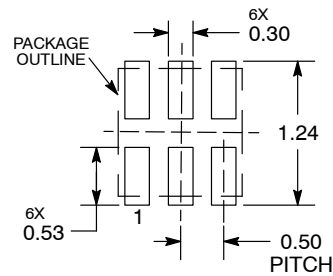
**DETAIL B**  
OPTIONAL  
CONSTRUCTIONS

**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 0.30 mm FROM THE TERMINAL TIP.

MILLIMETERS		
DIM	MIN	MAX
A	0.45	0.55
A1	0.00	0.05
A2	0.07 REF	
b	0.20	0.30
D	1.45 BSC	
E	1.00 BSC	
e	0.50 BSC	
L	0.30	0.40
L1	---	0.15

**MOUNTING 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.

**GENERIC  
MARKING DIAGRAM\***



X = Specific Device Code  
M = Date Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

<b>DOCUMENT NUMBER:</b>	<b>98AON30313E</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>UDFN6, 1.45x1.0, 0.5P</b>	<b>PAGE 1 OF 1</b>

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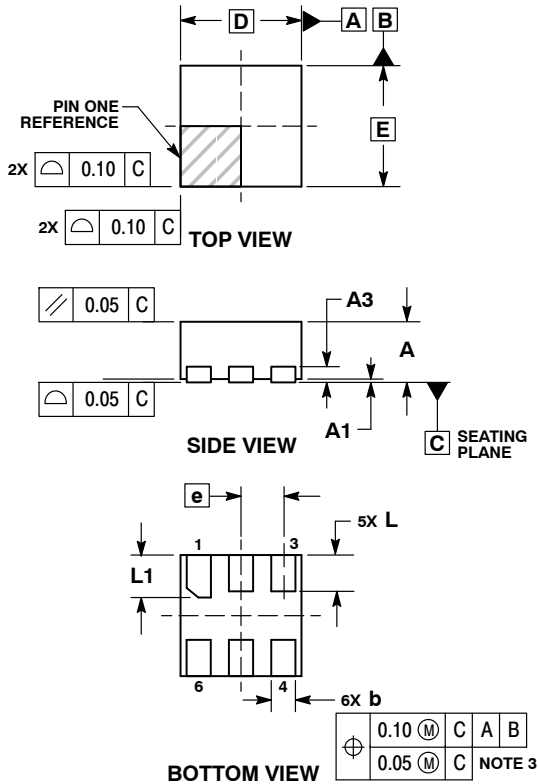
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



UDFN6, 1x1, 0.35P  
CASE 517BX  
ISSUE O

SCALE 4:1

DATE 18 MAY 2011

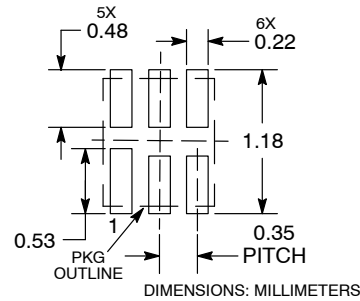


NOTES:

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. PACKAGE DIMENSIONS EXCLUSIVE OF BURRS AND MOLD FLASH.

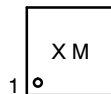
MILLIMETERS		
DIM	MIN	MAX
A	0.45	0.55
A1	0.00	0.05
A3	0.13	REF
b	0.12	0.22
D	1.00	BSC
E	1.00	BSC
e	0.35	BSC
L	0.25	0.35
L1	0.30	0.40

**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.

**GENERIC  
MARKING DIAGRAM\***



X = Specific Device Code  
M = Date Code

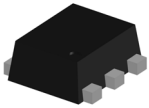
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

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<b>DESCRIPTION:</b>	<b>UDFN6, 1x1, 0.35P</b>	<b>PAGE 1 OF 1</b>

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS



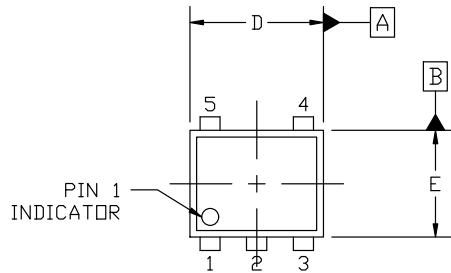
**SOT-953 1.00x0.80x0.37, 0.35P**  
**CASE 527AE**  
**ISSUE F**

DATE 17 JAN 2024

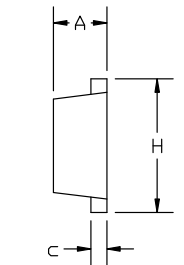
**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
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.

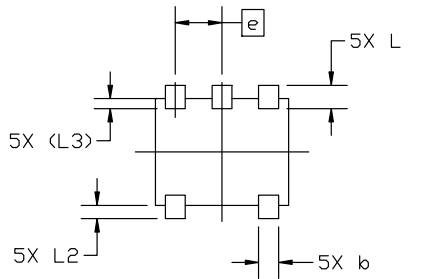
MILLIMETERS			
DIM	MIN	NOM	MAX
A	0.34	0.37	0.40
b	0.10	0.15	0.20
C	0.07	0.12	0.17
D	0.95	1.00	1.05
E	0.75	0.80	0.85
e	0.35 BSC		
H	0.95	1.00	1.05
L	0.125	0.175	0.225
L2	0.05	0.10	0.15
L3	0.075 (REF)		



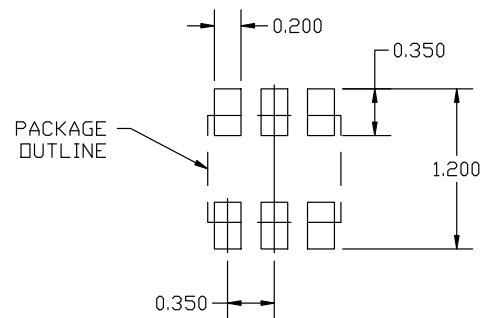
TOP VIEW



SIDE VIEW



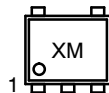
BOTTOM VIEW



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.

**GENERIC MARKING DIAGRAM\***



X = Specific Device Code  
M = Month Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

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