

Unbuffered Inverter

NL17SGU04

The NL17SGU04 MiniGate™ is an advanced high-speed CMOS unbuffered inverter in ultra-small footprint.

The NL17SGU04 input structure provides protection when voltages up to 3.6 V are applied.

Features

- Wide Operating V_{CC} Range: 0.9 V to 3.6 V
- High Speed: $t_{PD} = 1.9$ ns (Typ) at $V_{CC} = 3.0$ V, $C_L = 15$ pF
- Low Power Dissipation: $I_{CC} = 0.5$ μ A (Max) at $T_A = 25^\circ$ C
- 3.6 V Overvoltage Tolerant (OVT) Input Pin
- Ultra-Small Packages
- -Q Suffix 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

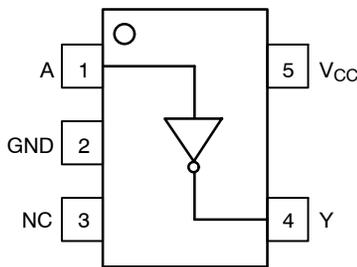


Figure 1. SOT-953
(Top Thru View)

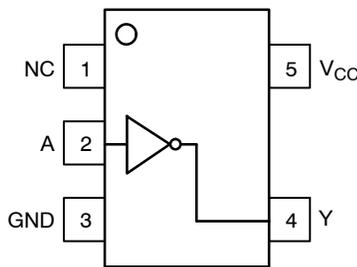


Figure 2. SC-88A
(Top View)

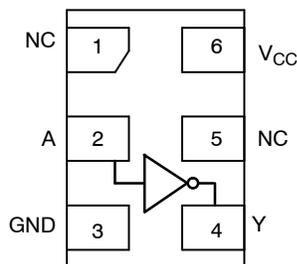


Figure 3. UDFN
(Top View)

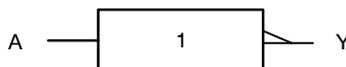
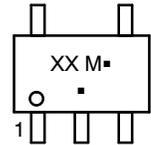


Figure 4. Logic Symbol

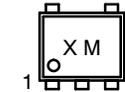
MARKING DIAGRAMS



SC-88A
DF SUFFIX
CASE 419A



SOT-953
P5 SUFFIX
CASE 527AE



UDFN6
1.45 x 1.0
CASE 517AQ



UDFN6
1.0 x 1.0
CASE 517BX



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

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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
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		±20 mA
I _{CC} or I _{GND}	DC Supply Current Per Supply Pin or Ground Pin		±20 mA
T _{STG}	Storage Temperature Range		-65 to +150 °C
T _L	Lead Temperature, 1 mm from Case for 10 Seconds		260 °C
T _J	Junction Temperature Under Bias		+150 °C
θ _{JA}	Thermal Resistance (Note 2)	SC-88A SOT-953 UDFN6	377 254 154 °C/W
P _D	Power Dissipation in Still Air at 85°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)		±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 V _{CC} 0 3.6 0 3.6	V
T _A	Operating Free-Air Temperature	-55	+125	°C
t _r , t _f	Input Transition Rise or Fall Rate	V _{CC} = 3.3 V ± 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.

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DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V _{CC} (V)	T _A = 25°C			T _A = -55°C to +125°C		Unit
				Min	Typ	Max	Min	Max	
V _{IH}	High-Level Input Voltage		0.9	-	V _{CC}	-	-	-	V
			1.1 to 1.3	0.8 x V _{CC}	-	-	0.8 x V _{CC}	-	
			1.4 to 1.6	0.8 x V _{CC}	-	-	0.8 x V _{CC}	-	
			1.65 to 1.95	0.8 x V _{CC}	-	-	0.8 x V _{CC}	-	
			2.3 to 2.7	0.8 x V _{CC}	-	-	0.8 x V _{CC}	-	
			3.0 to 3.6	0.8 x V _{CC}	-	-	0.8 x V _{CC}	-	
V _{IL}	Low-Level Input Voltage		0.9	-	GND	-	-	-	V
			1.1 to 1.3	-	-	0.2 x V _{CC}	-	0.2 x V _{CC}	
			1.4 to 1.6	-	-	0.2 x V _{CC}	-	0.2 x V _{CC}	
			1.65 to 1.95	-	-	0.2 x V _{CC}	-	0.2 x V _{CC}	
			2.3 to 2.7	-	-	0.2 x V _{CC}	-	0.2 x V _{CC}	
			3.0 to 3.6	-	-	0.2 x V _{CC}	-	0.2 x V _{CC}	
V _{OH}	High-Level Output Voltage	V _{IN} = V _{IH} or V _{IL}							V
		I _{OH} = -20 μA	0.9	-	0.75	-	-	-	
		I _{OH} = -0.3 mA	1.1 to 1.3	0.75 x V _{CC}	-	-	0.75 x V _{CC}	-	
		I _{OH} = -1.7 mA	1.4 to 1.6	0.75 x V _{CC}	-	-	0.75 x V _{CC}	-	
		I _{OH} = -3.0 mA	1.65 to 1.95	V _{CC} - 0.45	-	-	V _{CC} - 0.45	-	
		I _{OH} = -4.0 mA	2.3 to 2.7	2.0	-	-	2.0	-	
V _{OL}	Low-Level Output Voltage	V _{IN} = V _{IH} or V _{IL}							V
		I _{OL} = 20 μA	0.9	-	0.1	-	-	-	
		I _{OL} = 0.3 mA	1.1 to 1.3	-	-	0.25 x V _{CC}	-	0.25 x V _{CC}	
		I _{OL} = 1.7 mA	1.4 to 1.6	-	-	0.25 x V _{CC}	-	0.25 x V _{CC}	
		I _{OL} = 3.0 mA	1.65 to 1.95	-	-	0.45	-	0.45	
		I _{OL} = 4.0 mA	2.3 to 2.7	-	-	0.4	-	0.4	
I _{IN}	Input Leakage Current	V _{IN} = GND to 3.6 V	0.9 to 3.6	-	-	±0.1	-	±1.0	μA
I _{OFF}	Power Off Leakage Current	V _{IN} = 0 V to 3.6 V	0	-	-	1.0	-	10.0	μA
I _{CC}	Quiescent Supply Current	V _{IN} = V _{CC} 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.

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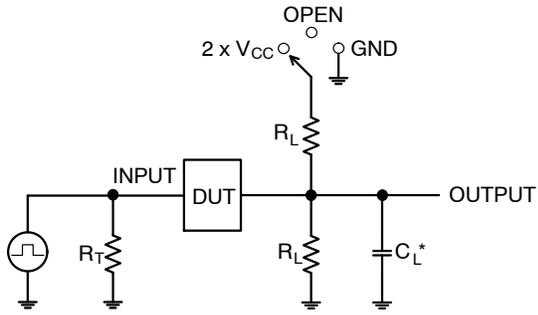
AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Condition	V _{CC} (V)	T _A = 25°C			T _A = -55°C to +125°C		Unit		
				Min	Typ	Max	Min	Max			
t _{PLH} , t _{PHL}	Propagation Delay, A to Y	C _L = 10 pF, R _L = 1 MΩ	0.9	-	12.7	-	-	-	ns		
			1.1 to 1.3	-	6.0	9.2	-	12.2			
			1.4 to 1.6	-	3.2	8.5	-	10.0			
			1.65 to 1.95	-	2.6	6.2	-	6.7			
			2.3 to 2.7	-	2.0	3.9	-	4.4			
			3.0 to 3.6	-	1.7	3.1	-	3.7			
		C _L = 15 pF, R _L = 1 MΩ	0.9	-	13.0	-	-	-	ns		
			1.1 to 1.3	-	7.0	9.4	-	12.2			
			1.4 to 1.6	-	3.5	6.3	-	10.2			
			1.65 to 1.95	-	3.0	5.9	-	7.1			
			2.3 to 2.7	-	2.3	4.4	-	5.0			
		C _L = 30 pF, R _L = 1 MΩ	0.9	-	14.1	-	-	-	ns		
			1.1 to 1.3	-	9.0	11.6	-	13.8			
			1.4 to 1.6	-	6.0	9.1	-	12.9			
			1.65 to 1.95	-	4.5	8.2	-	9.6			
			2.3 to 2.7	-	3.2	5.7	-	6.1			
					3.0 to 3.6	-	2.5	4.4	-	4.8	
		C _{IN}	Input Capacitance		0 to 3.6		3	-	-	-	pF
C _O	Output Capacitance	V _O = GND	0		3	-	-	-	pF		
C _{PD}	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_{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} • V_{CC} • f_{in} + I_{CC}. C_{PD} is used to determine the no-load dynamic power consumption; P_D = C_{PD} • V_{CC}² • f_{in} + I_{CC} • V_{CC}.

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

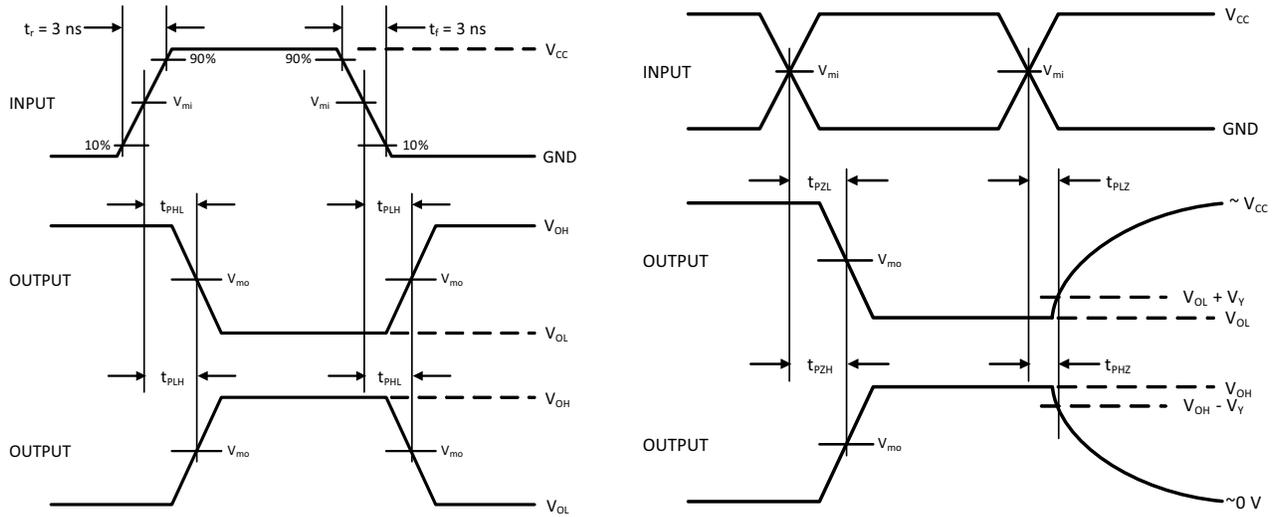


Figure 6. Switching Waveforms

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

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ORDERING INFORMATION

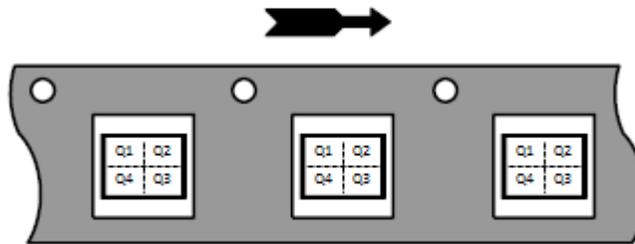
Device	Package	Marking	Pin 1 Orientation (See below)	Shipping [†]
NL17SGU04DFT2G	SC-88A	AY	Q4	3000 / Tape & Reel
NL17SGU04DFT2G-Q*	SC-88A	AY	Q4	3000 / Tape & Reel
NL17SGU04P5T5G	SOT-953	4	Q2	8000 / Tape & Reel
NL17SGU04MU1TCG	UDFN6, 1.45 x 1.0	3 (Rotated 180° CW)	Q4	3000 / Tape & Reel
NL17SGU04MU3TCG (Contact onsemi)	UDFN6, 1.0 x 1.0	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.

*-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



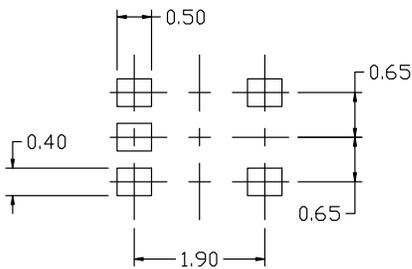
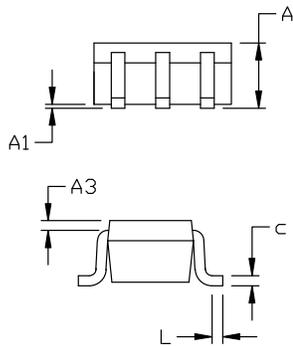
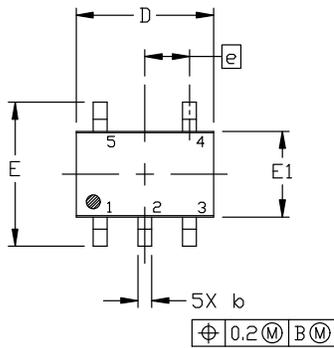
NL17SGU04

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.



**RECOMMENDED
MOUNTING FOOTPRINT**

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

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

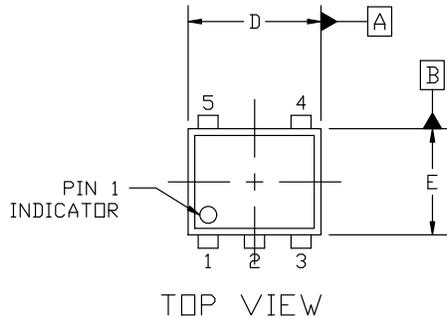
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PACKAGE DIMENSIONS

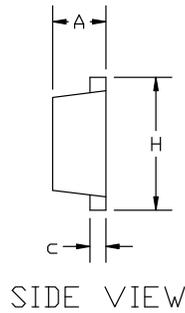
SOT-953 1.00x0.80x0.37, 0.35P
CASE 527AE
ISSUE F

NOTES:

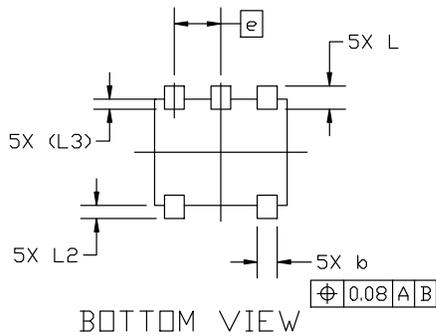
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.



TOP VIEW

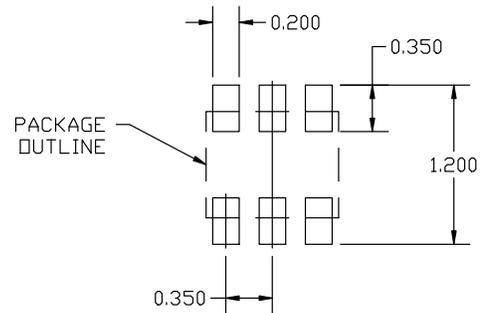


SIDE VIEW



BOTTOM VIEW

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)		



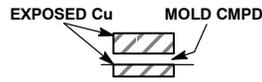
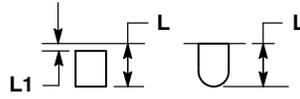
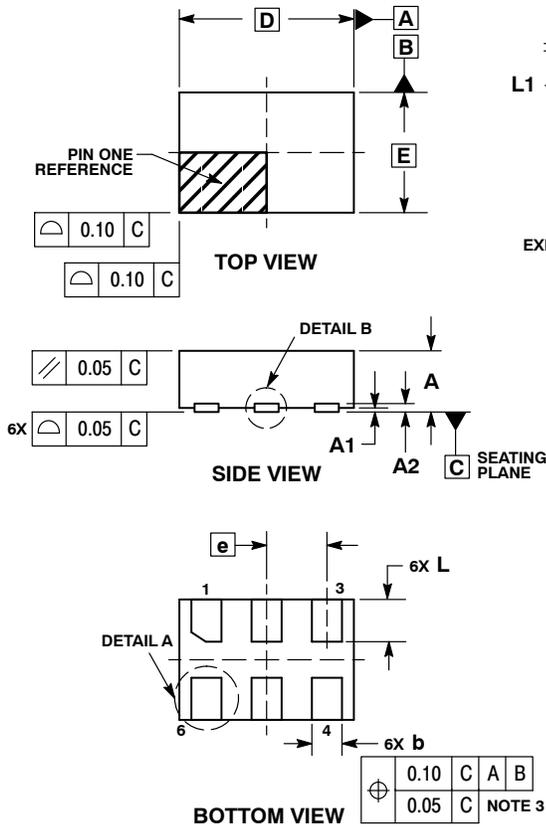
RECOMMENDED MOUNTING FOOTPRINT

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

NL17SGU04

PACKAGE DIMENSIONS

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

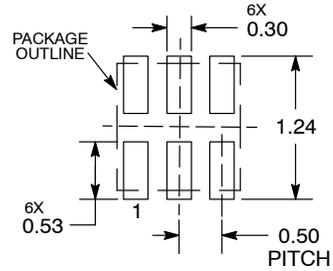


NOTES:

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



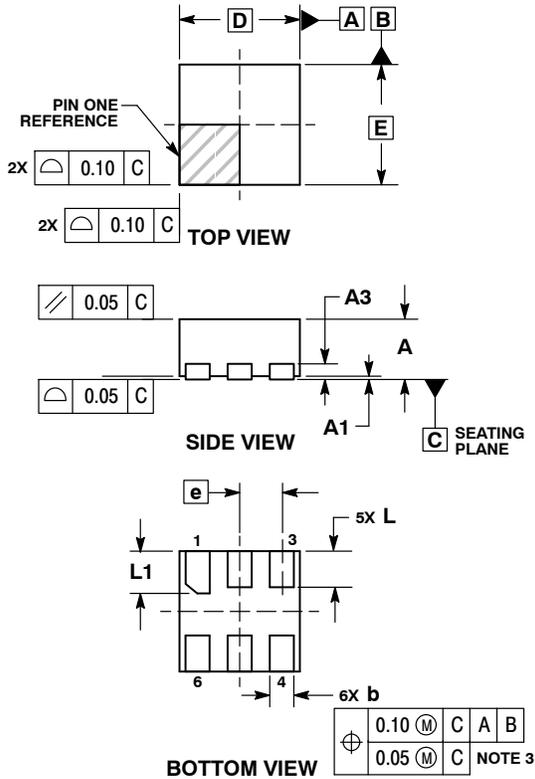
DIMENSIONS: MILLIMETERS

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

NL17SGU04

PACKAGE DIMENSIONS

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

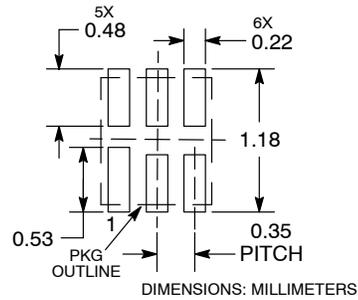


NOTES:

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.

DIM	MILLIMETERS	
	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*



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