

# TinyLogic ULP-A Inverter with Schmitt-Trigger Input

## NC7SP14

The NC7SP14 is a single inverter with Schmitt-Trigger Input in tiny footprint packages. The device is designed to operate for  $V_{CC} = 0.9\text{ V}$  to  $3.6\text{ V}$ .

### Features

- Designed for  $0.9\text{ V}$  to  $3.6\text{ V}$   $V_{CC}$  Operation
- $2.6\text{ ns}$   $t_{PD}$  at  $3.3\text{ V}$  (Typ)
- Inputs/Outputs Over-Voltage Tolerant up to  $3.6\text{ V}$
- $I_{OFF}$  Supports Partial Power Down Protection
- Source/Sink  $2.6\text{ mA}$  at  $3.3\text{ V}$
- Available in SC-88A and MicroPak™ Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

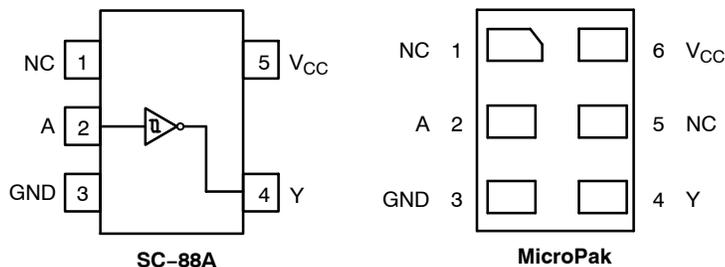


Figure 1. Pinout Diagrams (Top Views)

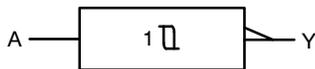


Figure 2. Logic Symbol

### PIN ASSIGNMENT

Pin	SC-88A	MicroPak
1	N.C.	N.C.
2	A	A
3	GND	GND
4	Y	Y
5	$V_{CC}$	N.C.
6	-	$V_{CC}$

N.C. = No Connect

### FUNCTION TABLE

Input	Output
A	Y
L	H
H	L

X = Don't Care  
Z = High Impedance State



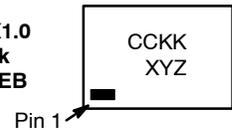
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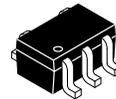
### MARKING DIAGRAMS



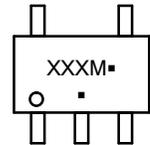
SIP6 1.45X1.0  
MicroPak  
CASE 127EB



- CC = Specific Device Code
- KK = 2-Digit Lot Run Traceability Code
- XY = 2-Digit Date Code
- Z = Assembly Plant Code



SC-88A  
CASE 419A-02



- XXX = Specific Device Code
- M = Date Code
- = Pb-Free Package

### ORDERING INFORMATION

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

# NC7SP14

## MAXIMUM RATINGS

Symbol	Characteristics	Value	Unit
V <sub>CC</sub>	DC Supply Voltage	-0.5 to +4.3	V
V <sub>IN</sub>	DC Input Voltage	-0.5 to +4.3	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 +4.3 -0.5 to +4.3	V
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
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	±50	mA
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C
T <sub>J</sub>	Junction Temperature Under Bias	+150	°C
θ <sub>JA</sub>	Thermal Resistance (Note 2) SC-88A MicroPak	377 154	°C/W
P <sub>D</sub>	Power Dissipation in Still Air SC-88A MicroPak	332 812	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 <sub>ESD</sub>	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.

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-1 inch, 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.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	Positive DC Supply Voltage	0.9	3.6	V
V <sub>IN</sub>	DC Input Voltage	0	3.6	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	V <sub>CC</sub>	
		0	3.6	
		0	3.6	
T <sub>A</sub>	Operating Temperature Range	-40	+85	°C
t <sub>r</sub> , t <sub>f</sub>	Input Transition Rise and Fall Time	0	No Limit	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	Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Unit
				Min	Typ	Max	Min	Max	
V <sub>P</sub>	Positive Threshold Voltage		0.9	-	0.62	-	-	-	V
			1.1	-	-	1.0	-	1.0	
			1.4	-	-	1.2	-	1.2	
			1.65	-	-	1.5	-	1.5	
			2.3	-	-	1.9	-	1.9	
			3.0	-	-	2.6	-	2.6	
V <sub>N</sub>	Negative Threshold Voltage		0.9	-	0.34	-	-	-	V
			1.1	0.15	-	-	0.15	-	
			1.4	0.2	-	-	0.2	-	
			1.65	0.25	-	-	0.25	-	
			2.3	0.4	-	-	0.4	-	
			3.0	0.6	-	-	0.6	-	
V <sub>H</sub>	Hysteresis Voltage		0.9	-	0.29	-	-	-	V
			1.1	0.08	-	0.6	0.08	0.6	
			1.4	0.09	-	0.8	0.09	0.8	
			1.65	0.1	-	1.0	0.1	1.0	
			2.3	0.25	-	1.1	0.25	1.1	
			3.0	0.6	-	1.8	0.6	1.8	
V <sub>OH</sub>	High-Level Output Voltage	V <sub>IN</sub> = V <sub>P</sub> or V <sub>N</sub>							V
		I <sub>OH</sub> = -20 μA	0.9	-	V <sub>CC</sub> - 0.1	-	-	-	
			1.1 to 1.3	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	
			1.4 to 1.6	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	
			1.65 to 1.95	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	
			2.3 to 2.7	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	
			3.0 to 3.6	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	
		I <sub>OH</sub> = -0.5 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 mA	1.4 to 1.6	1.07	-	-	0.99	-	
		I <sub>OH</sub> = -1.5 mA	1.65 to 1.95	1.24	-	-	1.22	-	
		I <sub>OH</sub> = -2.1 mA	2.3 to 2.7	1.95	-	-	1.87	-	
I <sub>OH</sub> = -2.6 mA	3.0 to 3.6	2.61	-	-	2.55	-			
V <sub>OL</sub>	Low-Level Output Voltage	V <sub>IN</sub> = V <sub>P</sub> or V <sub>N</sub>							V
		I <sub>OL</sub> = 20 μA	0.9	-	0.1	-	-	-	
			1.1 to 1.3	-	-	0.1	-	0.1	
			1.4 to 1.6	-	-	0.1	-	0.1	
			1.65 to 1.95	-	-	0.1	-	0.1	
			2.3 to 2.7	-	-	0.1	-	0.1	
			3.0 to 3.6	-	-	0.1	-	0.1	
		I <sub>OL</sub> = 0.5 mA	1.1 to 1.3	-	-	0.3 x V <sub>CC</sub>	-	0.3 x V <sub>CC</sub>	
		I <sub>OL</sub> = 1 mA	1.4 to 1.6	-	-	0.31	-	0.37	
		I <sub>OL</sub> = 1.5 mA	1.65 to 1.95	-	-	0.31	-	0.35	
		I <sub>OL</sub> = 2.1 mA	2.3 to 2.7	-	-	0.31	-	0.33	
I <sub>OL</sub> = 2.6 mA	3.0 to 3.6	-	-	0.31	-	0.33			

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## DC ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Unit
				Min	Typ	Max	Min	Max	
I <sub>IN</sub>	Input Leakage Current	V <sub>IN</sub> = 0 V to 3.6 V	0.9 to 3.6	-	-	±0.1	-	±0.5	μA
I <sub>OFF</sub>	Power Off Leakage Current	V <sub>IN</sub> = 0 V to 3.6 V or V <sub>OUT</sub> = 0 V to 3.6 V	0	-	-	0.5	-	0.5	μA
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	0.9 to 3.6	-	-	0.9	-	0.9	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

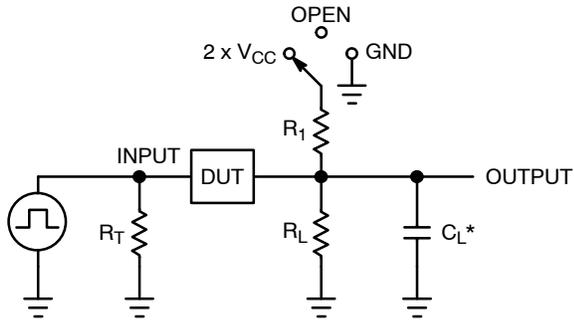
Symbol	Parameter	Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Unit
				Min	Typ	Max	Min	Max	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, A to Y (Figures 3 and 4)	R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 10 pF	0.9	-	47.9	-	-	-	ns
			1.10 to 1.30	-	12.8	27.0	-	34.3	
			1.40 to 1.60	-	6.6	14.8	-	15.0	
			1.65 to 1.95	-	4.7	12.0	-	12.2	
			2.3 to 2.7	-	3.1	9.4	-	9.9	
			3.0 to 3.6	-	2.6	8.3	-	9.0	
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	0.9	-	49.3	-	-	-	ns
			1.10 to 1.30	-	13.3	28.3	-	37.3	
			1.40 to 1.60	-	7.0	15.5	-	16.5	
			1.65 to 1.95	-	5.1	12.6	-	13.6	
			2.3 to 2.7	-	3.4	9.9	-	10.8	
			3.0 to 3.6	-	2.7	8.7	-	9.5	
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> = 30 pF	0.9	-	53.6	-	-	-	ns
			1.10 to 1.30	-	14.9	32.4	-	46.3	
			1.40 to 1.60	-	8.3	17.8	-	18.2	
			1.65 to 1.95	-	6.2	14.4	-	15.9	
			2.3 to 2.7	-	4.1	11.3	-	12.8	
			3.0 to 3.6	-	3.3	9.2	-	10.7	

## CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition	Typical (T <sub>A</sub> = 25°C)	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>CC</sub> = 0 V	2.0	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>CC</sub> = 0 V	4.0	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Note 5)	f = 10 MHz, V <sub>CC</sub> = 0.9 to 3.6 V, V <sub>IN</sub> = 0 V or V <sub>CC</sub>	8.0	pF

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>.

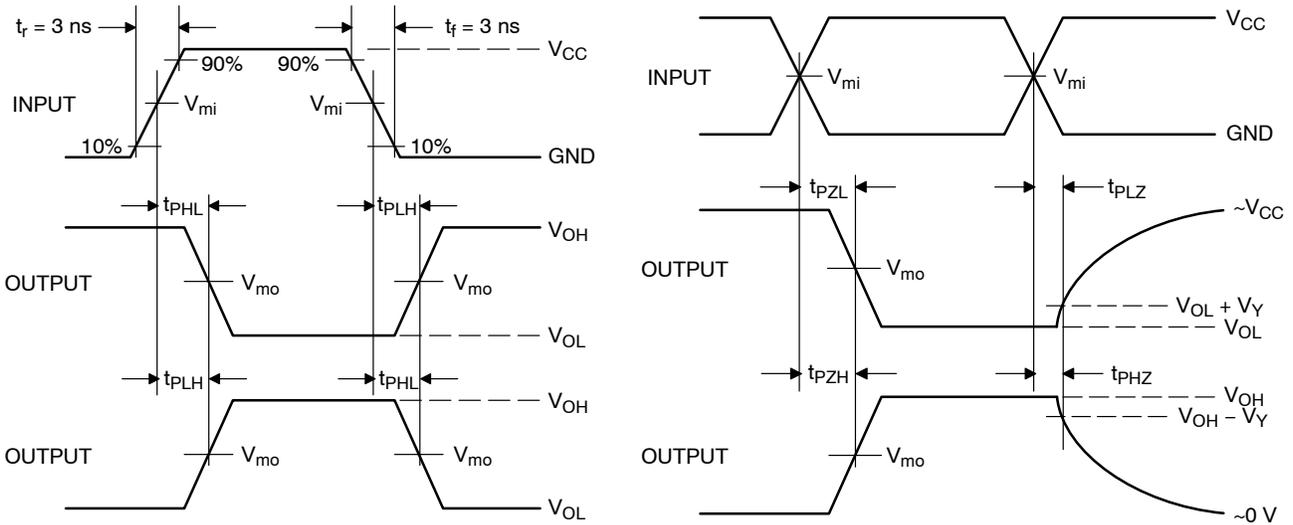
# NC7SP14



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

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

Figure 3. Test Circuit



$V_{CC}, V$	$V_{mi}, V$	$V_{mo}, V$	$V_Y, V$
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

Figure 4. Switching Waveforms

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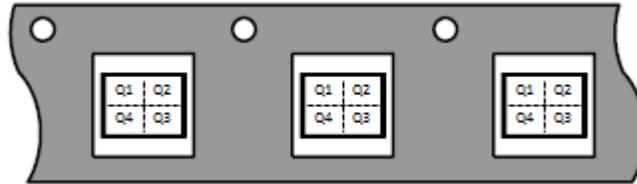
## ORDERING INFORMATION

Device	Package	Marking	Pin 1 Orientation (See below)	Shipping <sup>†</sup>
NC7SP14P5X	SC-88A	P14	Q4	3000 / Tape & Reel
NC7SP14L6X	MicroPak	K3	Q4	5000 / Tape & Reel

<sup>†</sup>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.

### Pin 1 Orientation in Tape and Reel

Direction of Feed



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**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**

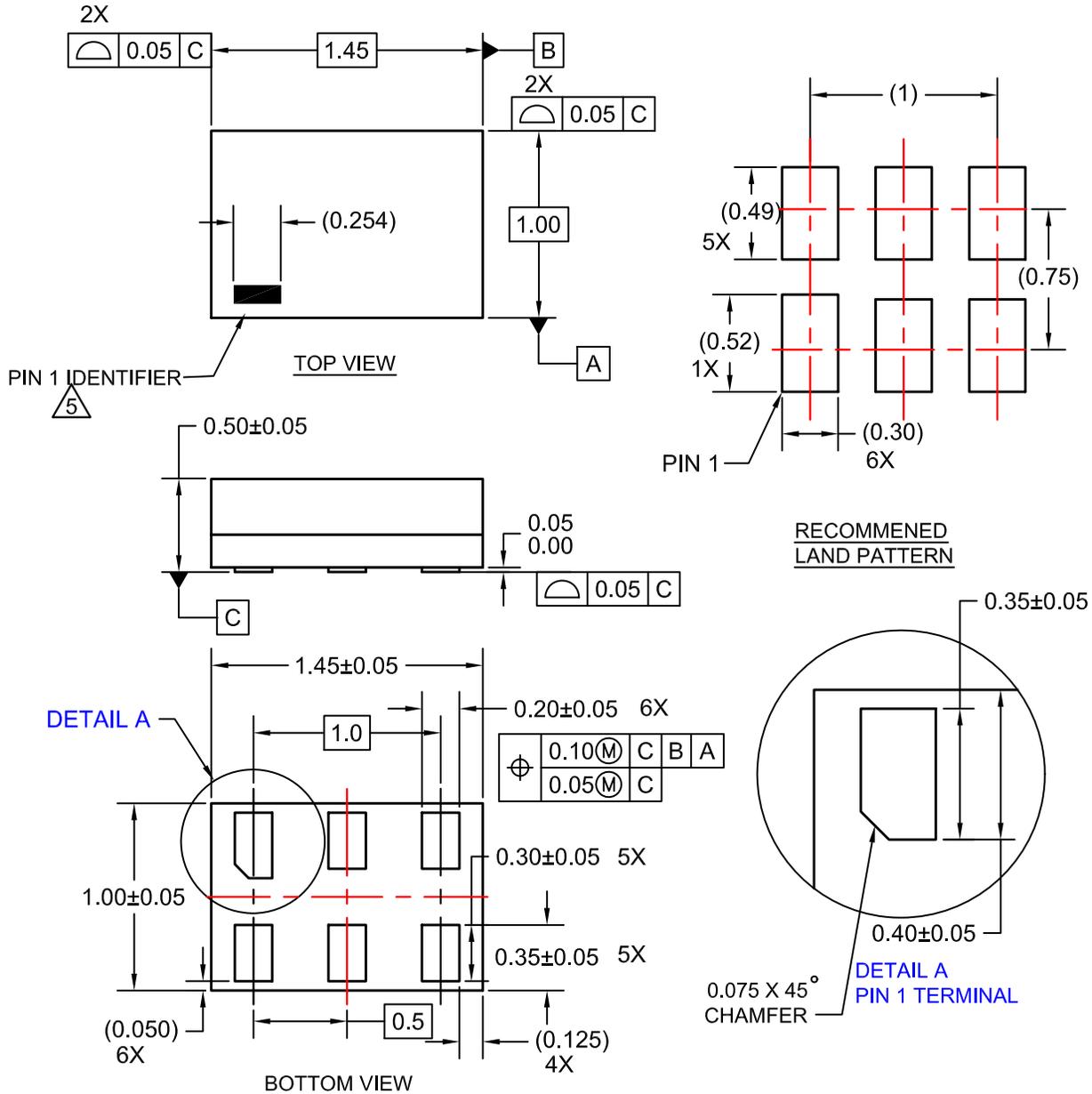
NC7SP14

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SIP6 1.45X1.0  
CASE 127EB  
ISSUE O

DATE 31 AUG 2016



NOTES:

1. CONFORMS TO JEDEC STANDARD MO-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-2009
4. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY OTHER LINE IN THE MARK CODE LAYOUT.

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<b>DESCRIPTION:</b>	<b>SIP6 1.45X1.0</b>	<b>PAGE 1 OF 9</b>

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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

NC7SP14

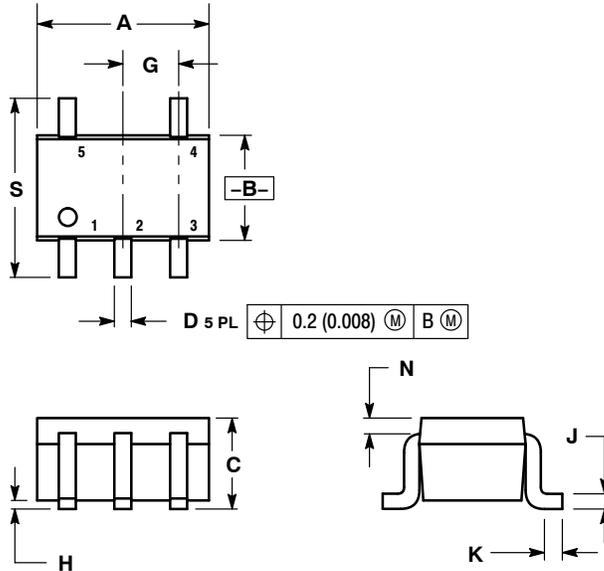
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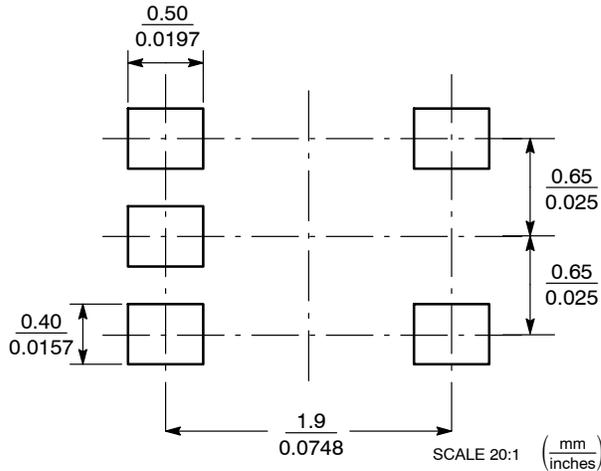
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SC-88A (SC-70-5/SOT-353)  
CASE 419A-02  
ISSUE L

DATE 17 JAN 2013



### SOLDER FOOTPRINT

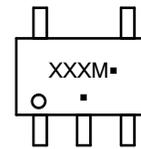


NOTES:

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

### GENERIC MARKING DIAGRAM\*



- XXX = Specific Device Code
- M = Date Code
- = Pb-Free Package

(Note: Microdot may be in either location)

\*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.

- |  |  |  |  |  |
|--|--|--|--|--|
| <p>STYLE 1:<br/>PIN 1. BASE<br/>2. EMITTER<br/>3. BASE<br/>4. COLLECTOR<br/>5. COLLECTOR</p>                   | <p>STYLE 2:<br/>PIN 1. ANODE<br/>2. EMITTER<br/>3. BASE<br/>4. COLLECTOR<br/>5. CATHODE</p>  | <p>STYLE 3:<br/>PIN 1. ANODE 1<br/>2. N/C<br/>3. ANODE 2<br/>4. CATHODE 2<br/>5. CATHODE 1</p> | <p>STYLE 4:<br/>PIN 1. SOURCE 1<br/>2. DRAIN 1/2<br/>3. SOURCE 2<br/>4. GATE 1<br/>5. GATE 2</p> | <p>STYLE 5:<br/>PIN 1. CATHODE<br/>2. COMMON ANODE<br/>3. CATHODE 2<br/>4. CATHODE 3<br/>5. CATHODE 4</p>  |
| <p>STYLE 6:<br/>PIN 1. EMITTER 2<br/>2. BASE 2<br/>3. EMITTER 1<br/>4. COLLECTOR<br/>5. COLLECTOR 2/BASE 1</p> | <p>STYLE 7:<br/>PIN 1. BASE<br/>2. EMITTER<br/>3. BASE<br/>4. COLLECTOR<br/>5. COLLECTOR</p> | <p>STYLE 8:<br/>PIN 1. CATHODE<br/>2. COLLECTOR<br/>3. N/C<br/>4. BASE<br/>5. EMITTER</p>      | <p>STYLE 9:<br/>PIN 1. ANODE<br/>2. CATHODE<br/>3. ANODE<br/>4. ANODE<br/>5. ANODE</p>           | <p>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.</p> |

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