

# TinyLogic ULP-A Unbuffered Inverter

## NC7SPU04

The NC7SPU04 is a single unbuffered inverter 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 V to 3.6 V  $V_{CC}$  Operation
- 4.0 ns  $t_{PD}$  at 3.3 V (Typ)
- Input Over-Voltage Tolerant up to 3.6 V
- Source/Sink 2.6 mA at 3.3 V
- Available in SC-88A and MicroPak™ Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

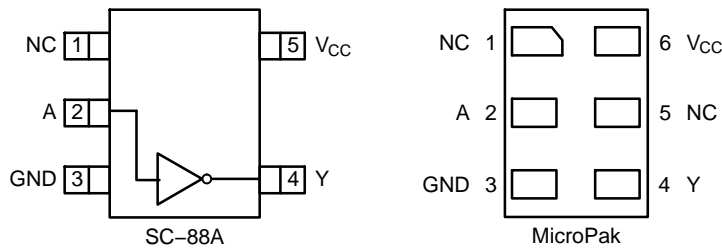


Figure 2. Pin Assignments for SC70

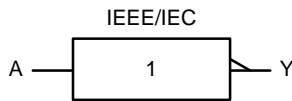


Figure 1. Logic Symbol

### 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

### FUNCTIONAL TABLE

Input	Output
A	Y
L	H
H	L

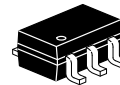
### MARKING DIAGRAM



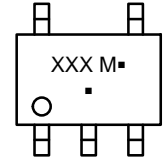
SIP6 1.45x1.0  
MicroPak  
CASE 127EB



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



SC-88A 1.25x2  
CASE 419AC-01



XXX = 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 and shipping information on page 6 of this data sheet.

# NC7SPU04

## MAXIMUM RATINGS

Symbol	Parameter	Value	Rating
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	-0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	DC Input Diode Current V <sub>IN</sub> < GND	-50	mA
I <sub>OK</sub>	DC Output Diode Current	±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 659 382	°C/W
P <sub>D</sub>	Power Dissipation in Still Air at 25°C	SC-88A MicroPak 190 327	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	4000 2000	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.
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>	Digital Input Voltage	0	3.6	V
V <sub>OUT</sub>	Output Voltage	0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Free-Air Temperature	-40	+85	°C
t <sub>r</sub> , t <sub>f</sub>	Input Transition Rise or Fall Rate V <sub>CC</sub> = 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.

# NC7SPU04

## DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	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>IH</sub>	High-Level Input Voltage		0.9	-	0.8 x V <sub>CC</sub>	-	-	-	V
			1.1 to 1.3	0.8 x V <sub>CC</sub>	-	-	0.8 x V <sub>CC</sub>	-	
			1.4 to 1.6	0.8 x V <sub>CC</sub>	-	-	0.8 x V <sub>CC</sub>	-	
			1.65 to 1.95	0.8 x V <sub>CC</sub>	-	-	0.8 x V <sub>CC</sub>	-	
			2.3 to 2.7	0.8 x V <sub>CC</sub>	-	-	0.8 x V <sub>CC</sub>	-	
			3.0 to 3.6	0.8 x V <sub>CC</sub>	-	-	0.8 x V <sub>CC</sub>	-	
V <sub>IL</sub>	Low-Level Input Voltage		0.9	-	0.2 x V <sub>CC</sub>	-	-	-	V
			1.1 to 1.3	-	-	0.2 x V <sub>CC</sub>	-	0.2 x V <sub>CC</sub>	
			1.4 to 1.6	-	-	0.2 x V <sub>CC</sub>	-	0.2 x V <sub>CC</sub>	
			1.65 to 1.95	-	-	0.2 x V <sub>CC</sub>	-	0.2 x V <sub>CC</sub>	
			2.3 to 2.7	-	-	0.2 x V <sub>CC</sub>	-	0.2 x V <sub>CC</sub>	
			3.0 to 3.6	-	-	0.2 x V <sub>CC</sub>	-	0.2 x V <sub>CC</sub>	
V <sub>OH</sub>	High-Level Output Voltage	V <sub>IN</sub> = V <sub>CC</sub> or GND	-	-	-	-	-	-	V
		I <sub>OH</sub> = -5 μA	0.9	-	V <sub>CC</sub> - 0.2	-	-	-	
		I <sub>OH</sub> = -20 μA	1.1 to 1.3	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.2	-	
			1.4 to 1.6	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.2	-	
			1.65 to 1.95	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.2	-	
			2.3 to 2.7	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.2	-	
			3.0 to 3.6	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.2	-	
		I <sub>OH</sub> = -0.5 mA	1.1 to 1.3	0.75 x V <sub>CC</sub>	-	-	0.70 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>CC</sub> or GND	-	-	-	-	-	-	V
		I <sub>OL</sub> = 5 μA	0.9	-	0.2	-	-	-	
		I <sub>OL</sub> = 20 μA	1.1 to 1.3	-	-	0.2	-	0.2	
			1.4 to 1.6	-	-	0.2	-	0.2	
			1.65 to 1.95	-	-	0.2	-	0.2	
			2.3 to 2.7	-	-	0.2	-	0.2	
			3.0 to 3.6	-	-	0.2	-	0.2	
		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	
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>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

# NC7SPU04

## AC ELECTRICAL CHARACTERISTICS

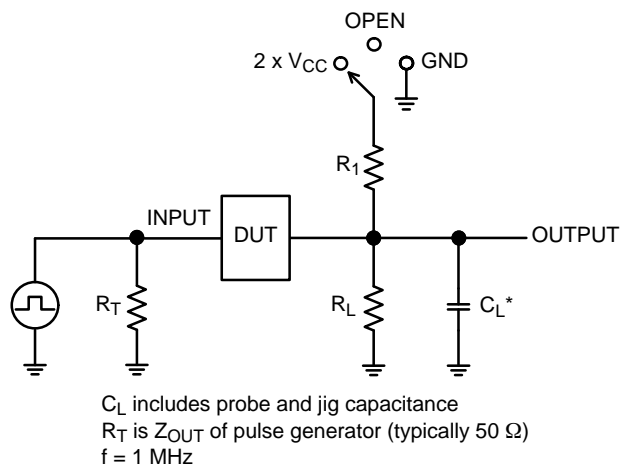
Symbol	Parameter	Test Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Unit
				Min	Typ	Max	Min	Max	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, A to Y (Figures 3 and 4)	R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 10 pF	0.9	-	15.6	-	-	-	ns
			1.1 to 1.3	-	8.0	21.8	-	34.3	
			1.4 to 1.6	-	7.0	14.8	-	15.0	
			1.65 to 1.95	-	6.0	12.0	-	12.2	
			2.3 to 2.7	-	5.0	9.4	-	9.9	
			3.0 to 3.6	-	4.0	8.3	-	9.0	
		R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF	0.9	-	16.3	-	-	-	ns
			1.1 to 1.3	-	9.0	22.8	-	37.3	
			1.4 to 1.6	-	8.0	15.5	-	16.5	
			1.65 to 1.95	-	6.0	12.6	-	13.6	
			2.3 to 2.7	-	5.0	9.9	-	10.8	
			3.0 to 3.6	-	4.0	8.7	-	9.5	
		R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 30 pF	0.9	-	18.3	-	-	-	ns
			1.1 to 1.3	-	10.0	25.9	-	46.3	
			1.4 to 1.6	-	9.0	17.8	-	18.2	
			1.65 to 1.95	-	7.0	14.4	-	15.9	
			2.3 to 2.7	-	6.0	11.3	-	12.8	
			3.0 to 3.6	-	5.0	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 V to 3.6 V, V <sub>IN</sub> = 0 V or V <sub>CC</sub>	8.0	pF

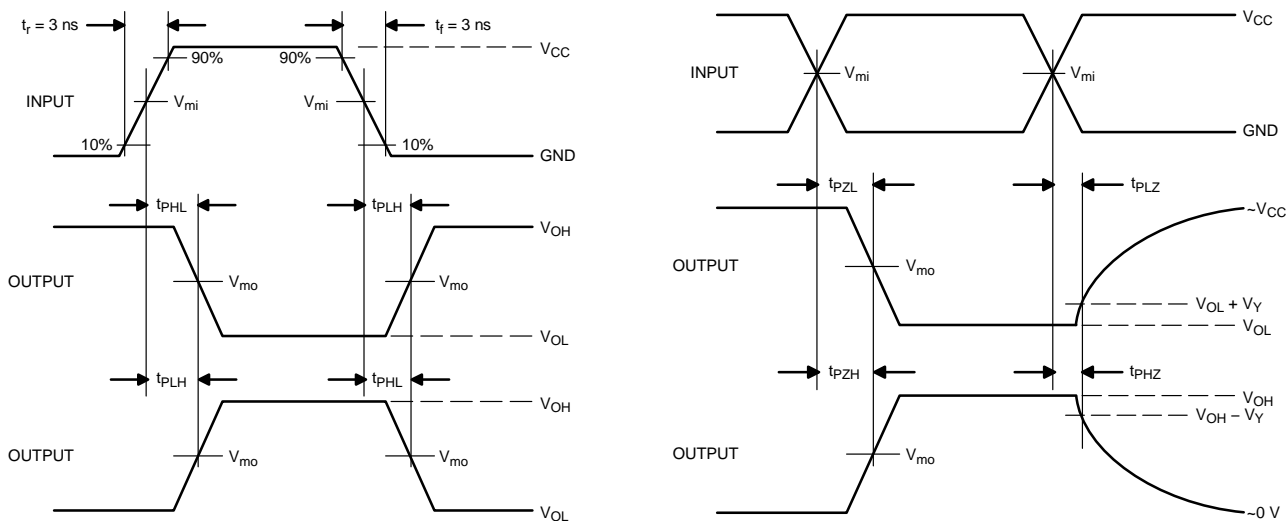
5. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the dynamic operating current consumption without load. Average operating current can be obtained by the equation  $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}$ . C<sub>PD</sub> is used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

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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



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

# NC7SPU04

## ORDERING INFORMATION

Order Number	Marking	Package	Pin 1 Orientation (See Below)	Shipping <sup>†</sup>
NC7SPU04P5X	PU4	SC-88A (Pb-Free)	Q4	3000 / Tape & Reel
NC7SPU04L6X	N3	SIP6, MicroPak (Pb-Free)	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.

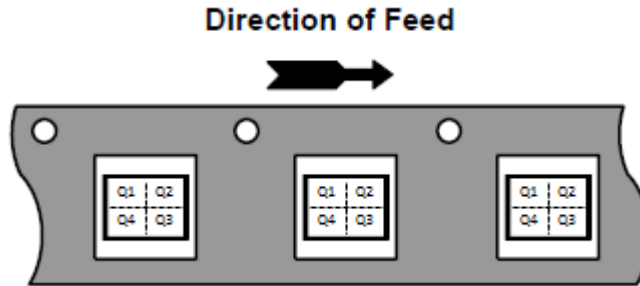


Figure 5. Pin 1 Orientation in Tape and Reel

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



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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# MECHANICAL CASE OUTLINE

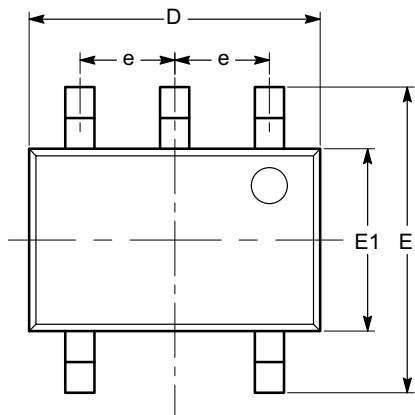
## PACKAGE DIMENSIONS

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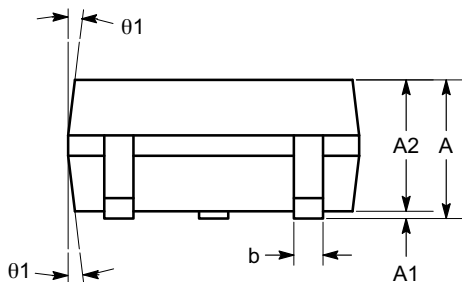
SC-88A (SC-70 5 Lead), 1.25x2  
CASE 419AC-01  
ISSUE A

DATE 29 JUN 2010

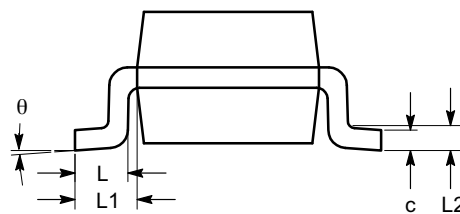


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	0.80		1.10
A1	0.00		0.10
A2	0.80		1.00
b	0.15		0.30
c	0.10		0.18
D	1.80	2.00	2.20
E	1.80	2.10	2.40
E1	1.15	1.25	1.35
e	0.65 BSC		
L	0.26	0.36	0.46
L1	0.42 REF		
L2	0.15 BSC		
$\theta$	0°		8°
$\theta_1$	4°		10°



SIDE VIEW



END VIEW

**Notes:**

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MO-203.

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