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 V to 3.6 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

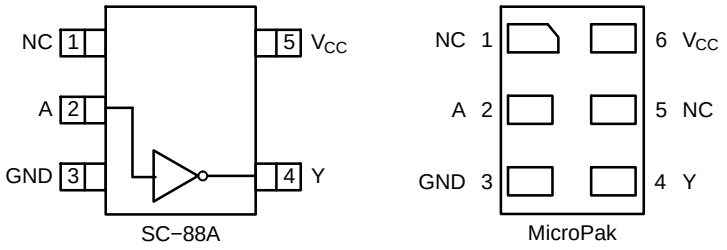


Figure 2. Pin Assignments for SC70

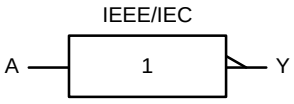


Figure 1. Logic Symbol

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

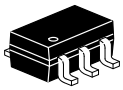
MARKING DIAGRAM



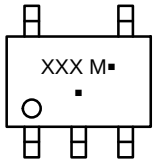
SIP6 1.45x1.0 MicroPak CASE 127EB



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.

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MAXIMUM RATINGS

Symbol	Parameter		Value	Rating
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		−0.5 to V_{CC} + 0.5	V
I_{IK}	DC Input Diode Current	V_{IN} < GND	−50	mA
I_{OK}	DC Output Diode Current		±50	mA
I_{OUT}	DC Output Source/Sink Current		±50	mA
$I_{CC\ or}\ I_{GND}$	DC Supply Current Per Supply Pin or Ground Pin		±50	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 MicroPak	659 382	°C/W
P_D	Power Dissipation in Still Air at 25ºC	SC−88A MicroPak	190 327	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	4000 2000	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 – 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_{CC}	Positive DC Supply Voltage		0.9	3.6	V
V_{IN}	Digital Input Voltage		0	3.6	V
V_{OUT}	Output Voltage		0	V_{CC}	V
T_A	Operating Free−Air Temperature		−40	+85	°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.

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = 25°C			T_A = −40°C to +85°C		Unit
				Min	Typ	Max	Min	Max	
V_{IH}	High−Level Input Voltage		0.9	−	0.8 x 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	−	0.2 x V_{CC}	−	−	−	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_{CC} or GND	−	−	−	−	−	−	V
		I_{OH} = −5 μA	0.9	−	V_{CC} – 0.2	−	−	−	
		I_{OH} = −20 μA	1.1 to 1.3	V_{CC} – 0.2	−	−	V_{CC} – 0.2	−	
			1.4 to 1.6	V_{CC} – 0.2	−	−	V_{CC} – 0.2	−	
			1.65 to 1.95	V_{CC} – 0.2	−	−	V_{CC} – 0.2	−	
			2.3 to 2.7	V_{CC} – 0.2	−	−	V_{CC} – 0.2	−	
			3.0 to 3.6	V_{CC} – 0.2	−	−	V_{CC} – 0.2	−	
		I_{OH} = −0.5 mA	1.1 o 1.3	0.75 x V_{CC}	−	−	0.70 x V_{CC}	−	
		I_{OH} = −1 mA	1.4 to 1.6	1.07	−	−	0.99	−	
		I_{OH} = −1.5 mA	1.65 to 1.95	1.24	−	−	1.22	−	
		I_{OH} = −2.1 mA	2.3 to 2.7	1.95	−	−	1.87	−	
		I_{OH} = −2.6 mA	3.0 to 3.6	2.61	−	−	2.55	−	
V_{OL}	Low−Level Output Voltage	V_{IN} = V_{CC} or GND	−	−	−	−	−	−	V
		I_{OL} = 5 μA	0.9	−	0.2	−	−	−	
		I_{OL} = 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_{OL} = 0.5 mA	1.1 o 1.3	−	−	0.3 x V_{CC}	−	0.3 x V_{CC}	
		I_{OL} = 1 mA	1.4 to 1.6	−	−	0.31	−	0.37	
		I_{OL} = 1.5 mA	1.65 to 1.95	−	−	0.31	−	0.35	
		I_{OL} = 2.1 mA	2.3 to 2.7	−	−	0.31	−	0.33	
		I_{OL} = 2.6 mA	3.0 to 3.6	−	−	0.31	−	0.33	
I_{IN}	Input Leakage Current	V_{IN} = 0 V to 3.6 V	0.9 to 3.6	−	−	±0.1	−	±0.5	μA
I_{CC}	Quiescent Supply Current	V_{IN} = V_{CC} or GND	0.9 to 3.6	−	−	0.9	−	0.9	μA

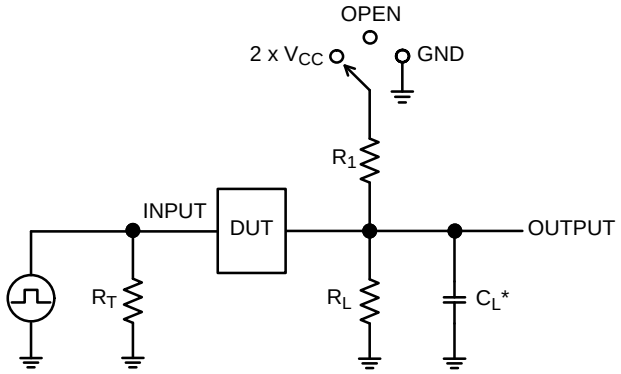
AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Condition	V_{CC} (V)	T_A = 25°C			T_A = −40°C to +85°C		Unit
				Min	Typ	Max	Min	Max	
t_{PLH}, t_{PHL}	Propagation Delay, A to Y (Figures 3 and 4)	R_L = 1 MΩ, C_L = 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_L = 1 MΩ, C_L = 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_L = 1 MΩ, C_L = 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_A = 25°C	Unit
C_{IN}	Input Capacitance	V_{CC} = 0 V	2.0	pF
C_{OUT}	Output Capacitance	V_{CC} = 0 V	4.0	pF
C_{PD}	Power Dissipation Capacitance (Note 5)	f = 10 MHz, V_{CC} = 0.9 V to 3.6 V, V_{IN} = 0 V or V_{CC}	8.0	pF

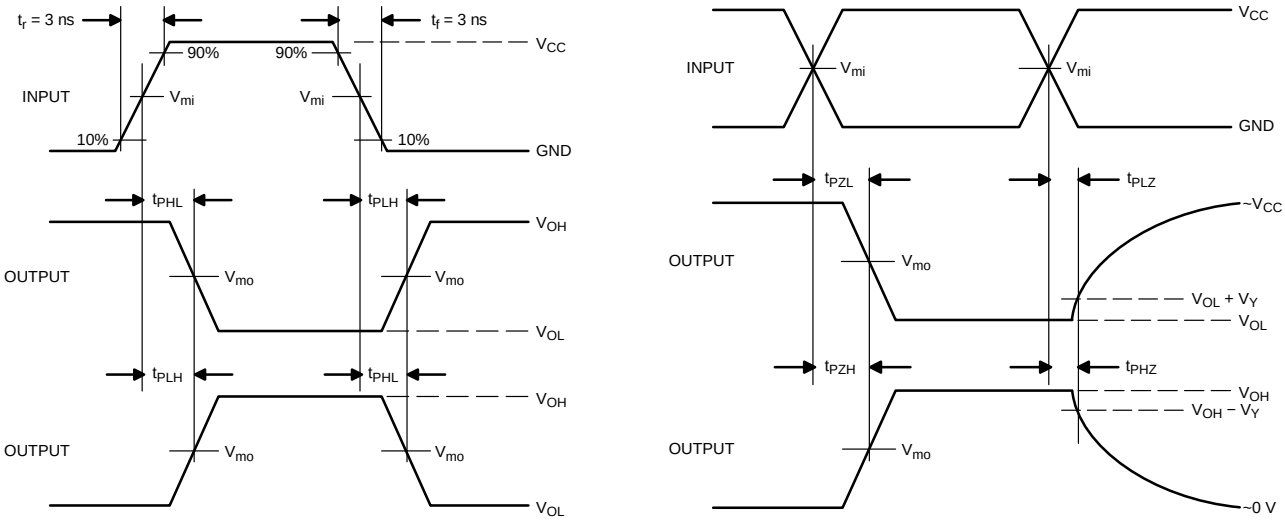
5. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the dynamic operating current consumption without load. Average operating current can be obtained by the equation $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}$. C_{PD} is used to determine 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
t_{PLH} / t_{PHL}	Open
t_{PLZ} / t_{PZL}	2 x V_{CC}
t_{PHZ} / t_{PZH}	GND

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

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

ORDERING INFORMATION

Order Number	Marking	Package	Pin 1 Orientation (See Below)	Shipping†
NC7SPU04P5X	PU4	SC−88A (Pb−Free)	Q4	3000 / Tape & Reel
NC7SPU04L6X	N3	SIP6, MicroPak (Pb−Free)	Q4	5000 / 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.

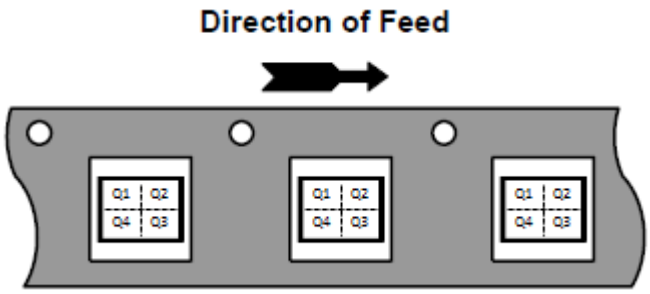
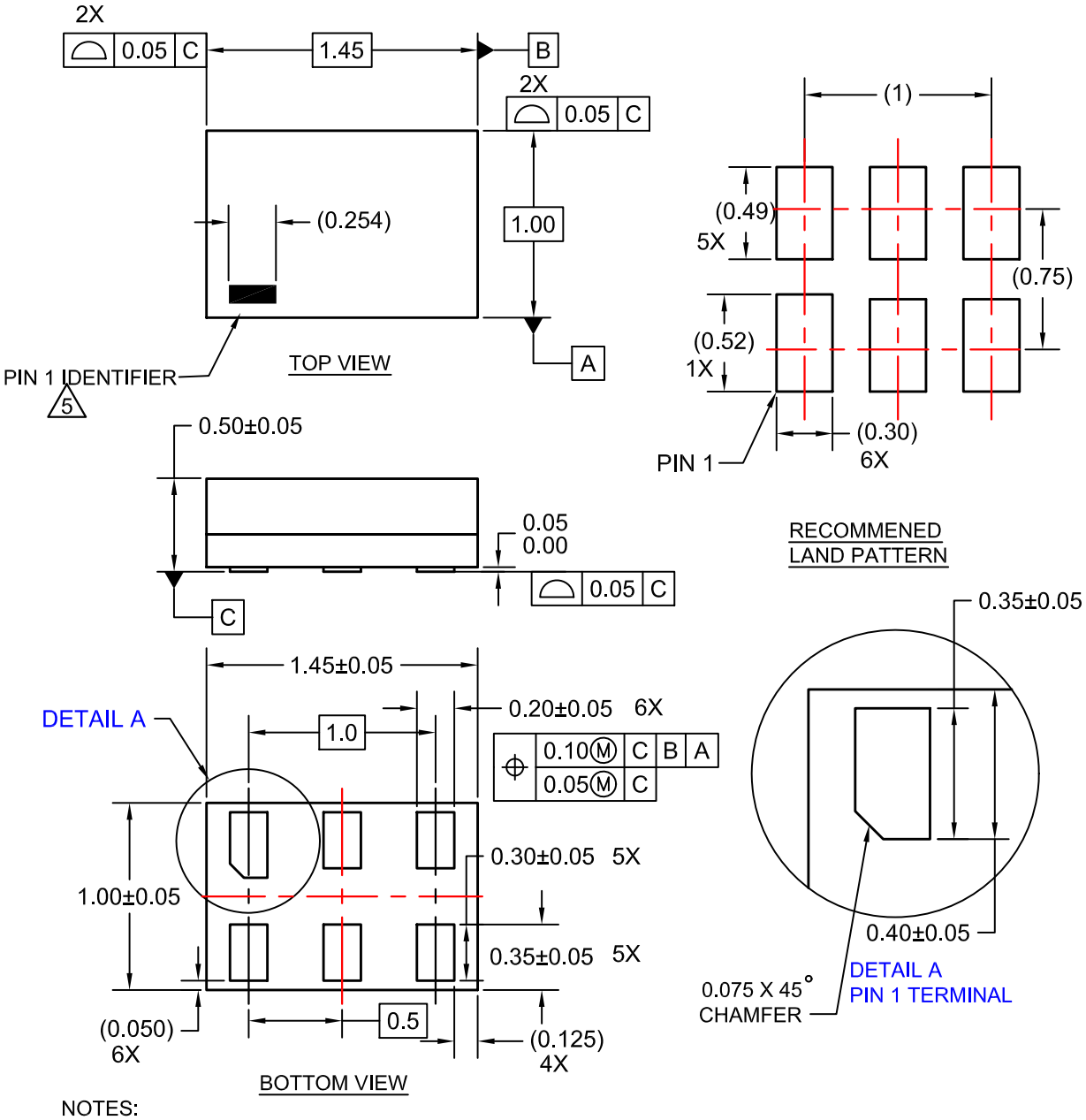


Figure 5. Pin 1 Orientation in Tape and Reel

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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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