

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 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

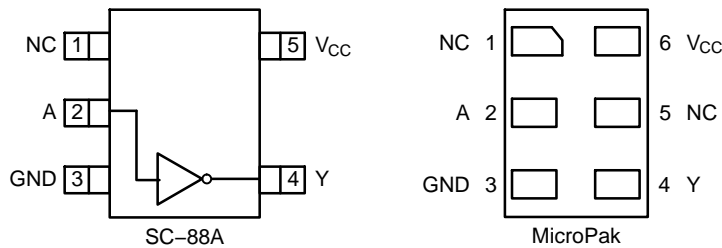


Figure 2. Pin Assignments for SC70

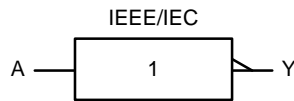


Figure 1. Logic Symbol

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 |

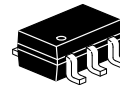
MARKING DIAGRAM



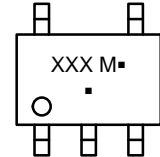
SIP6 1.45x1.0
MicroPak
CASE 127EB



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 _{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 25°C | 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.

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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 to 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 to 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 |

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AC ELECTRICAL CHARACTERISTICS

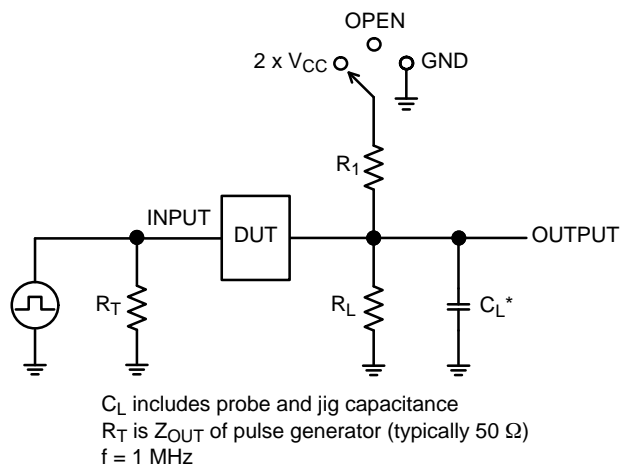
| Symbol | Parameter | Test Condition | V _{CC} (V) | T _A = 25°C | | | T _A = -40°C to +85°C | | Unit |
|--|---|--|---------------------|-----------------------|------|------|---------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | |
| t _{PLH} , t _{PHL} | Propagation 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 |

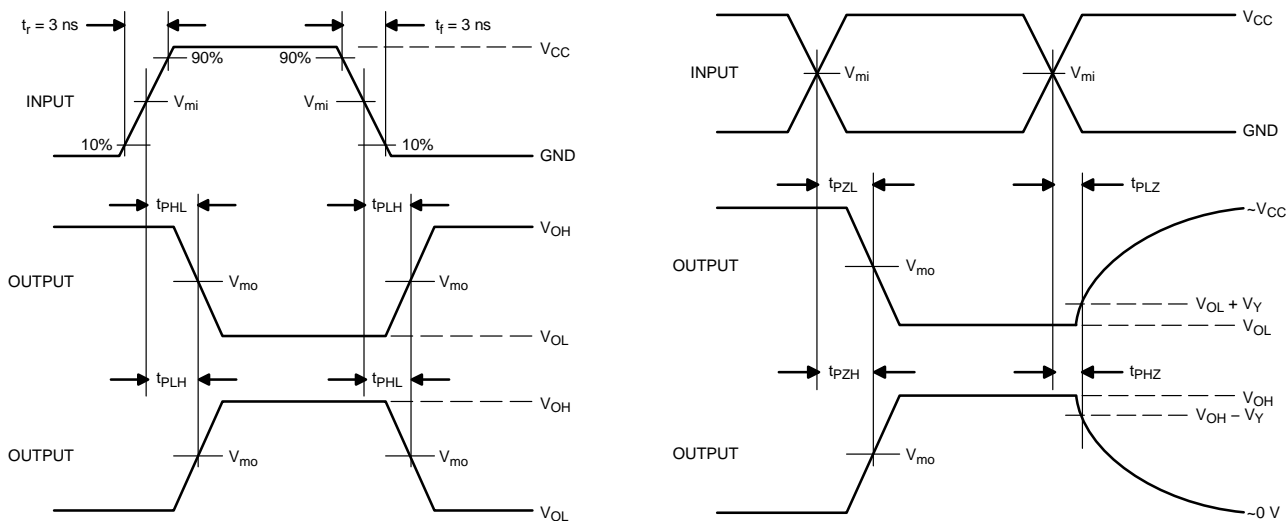
5. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the dynamic operating current consumption without load. Average operating current can be obtained by the equation I_{CC(OPR)} = C_{PD} • V_{CC} • f_{in} + I_{CC}. C_{PD} is used to determine the no-load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

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| 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

NC7SPU04

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.

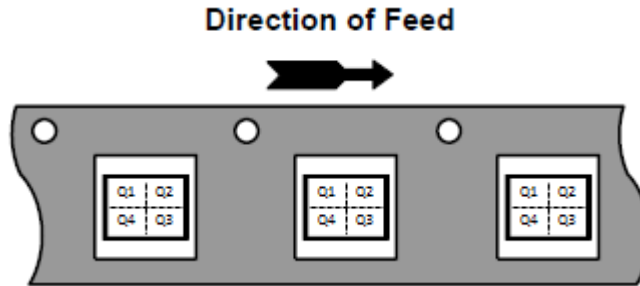


Figure 5. Pin 1 Orientation in Tape and Reel

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MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

ON Semiconductor®



SIP6 1.45X1.0
CASE 127EB
ISSUE O

DATE 31 AUG 2016



NOTES:

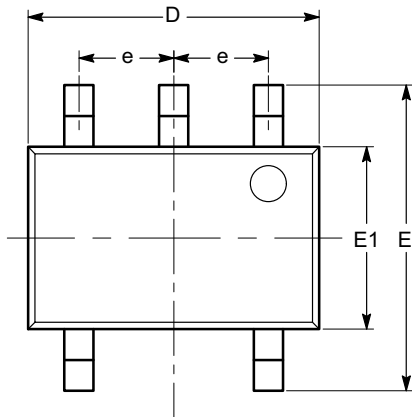
1. CONFORMS TO JEDEC STANDARD MO-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-2009
4. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY OTHER LINE IN THE MARK CODE LAYOUT.

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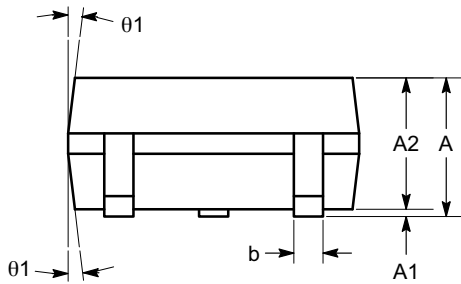
SC-88A (SC-70 5 Lead), 1.25x2
CASE 419AC-01
ISSUE A

DATE 29 JUN 2010

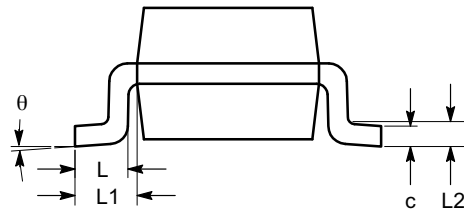


TOP VIEW

| 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 | | |
| θ | 0° | | 8° |
| θ_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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