

# TinyLogic HS Unbuffered Inverter

## NC7SU04

### Description

The NC7SU04 is a single special purpose CMOS Inverter. The inverter circuit is designed with a single unbuffered stage to facilitate use in crystal oscillator applications. It is not intended for use in logic inversion applications.

Advanced Silicon Gate CMOS fabrication assures high speed and low power circuit operation over a broad  $V_{CC}$  range. ESD protection diodes inherently guard both input and output with respect to the  $V_{CC}$  and GND rails.

### Features

- Space Saving SOT23-5, SC-74A and SC-88A 5-Lead Package
- Ultra Small MicroPak™ Leadless Package
- Unbuffered for Crystal Oscillator Applications
- Low Quiescent Power:  $I_{CC} < 1 \mu A$
- Balanced Output Drive: 2 mA  $I_{OL}$ , -2 mA  $I_{OH}$
- Broad  $V_{CC}$  Operating Range: 2 V – 6 V
- Balanced Propagation Delays
- Specified for 3 V Operation
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

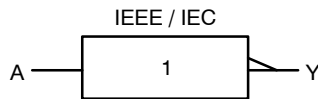
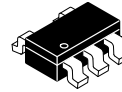
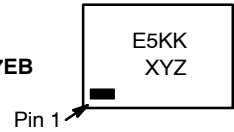


Figure 1. Logic Symbol

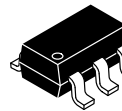
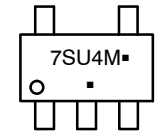
### MARKING DIAGRAMS



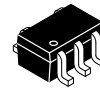
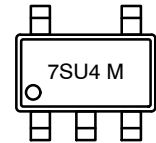
SIP6  
CASE 127EB



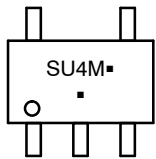
SC-74A  
CASE 318BQ



SOT23-5  
CASE 527AH



SC-88A  
CASE 419A-02



E5, 7SU4, SU4 = Specific Device Code  
KK = 2-Digit Lot Run Traceability Code  
XY = 2-Digit Date Code Format  
Z = Assembly Plant Code  
M = Data 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, marking and shipping information in the package dimensions section on page 5 of this data sheet.

# NC7SU04

## Pin Configurations



Figure 2. SOT23-5, SC-88A and SC-74A (Top View)



Figure 3. MicroPak (Top Through View)

### PIN DESCRIPTIONS

Pin Name	Description
A	Input
Y	Output
NC	No Connect

### FUNCTION TABLE (Y = $\bar{A}$ )

Inputs	Output
A	Y
L	H
H	L

H = HIGH Logic Level  
L = LOW Logic Level

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Max	Unit	
V <sub>CC</sub>	Supply Voltage	-0.5	6.5	V	
I <sub>IK</sub>	DC Input Diode Current	V <sub>IN</sub> < 0 V	-	mA	
		V <sub>IN</sub> > V <sub>CC</sub>	-		+20
V <sub>IN</sub>	DC Input Voltage	-0.5	V <sub>CC</sub> + 0.5	V	
I <sub>OK</sub>	DC Output Diode Current	V <sub>OUT</sub> < 0 V	-	mA	
		V <sub>OUT</sub> > V <sub>CC</sub>	-		+20
V <sub>OUT</sub>	DC Output Voltage	-0.5	V <sub>CC</sub> + 0.5	V	
I <sub>OUT</sub>	DC Output Source or Sink Current	-	±12.5	mA	
I <sub>CC</sub> or I <sub>GND</sub>	DC V <sub>CC</sub> or Ground Current per Output Pin	-	±25	mA	
T <sub>STG</sub>	Storage Temperature	-65	+150	°C	
T <sub>J</sub>	Junction Temperature	-	+150	°C	
T <sub>L</sub>	Lead Temperature (Soldering, 10 Seconds)	-	+260	°C	
P <sub>D</sub>	Power Dissipation in Still Air	SC-74A / SOT23-5	-	390	mW
		SC-88A	-	332	
		MicroPak-6	-	812	

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.

# NC7SU04

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	Supply Voltage		2.0	6.0	V
V <sub>IN</sub>	Input Voltage		0	V <sub>CC</sub>	V
V <sub>OUT</sub>	Output Voltage		0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature		-40	+85	°C
θ <sub>JA</sub>	Thermal Resistance	SC-74A / SOT23-5	-	320	°C/W
		SC-88A	-	377	
		MicroPak-6	-	154	

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.

1. Unused inputs must be held HIGH or LOW. They may not float.

## DC ELECTRICAL CHARACTERISTICS

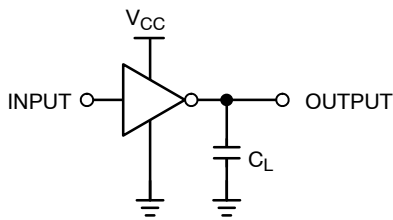
Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40 to +85°C		Unit
				Min	Typ	Max	Min	Max	
V <sub>IH</sub>	HIGH Level Input Voltage	2.0		1.70	-	-	1.70	-	V
		3.0		2.45	-	-	2.45	-	
		4.5		3.60	-	-	3.60	-	
		6.0		4.80	-	-	4.80	-	
V <sub>IL</sub>	LOW Level Input Voltage	2.0		-	-	0.30	-	0.30	V
		3.0		-	-	0.50	-	0.50	
		4.5		-	-	0.90	-	0.90	
		6.0		-	-	1.20	-	1.20	
V <sub>OH</sub>	HIGH Level Output Voltage	2.0	I <sub>OH</sub> = -20 μA V <sub>IN</sub> = V <sub>IL</sub>	1.80	2.0	-	1.80	-	V
		3.0		2.50	3.0	-	2.50	-	
		4.5	4.00	4.5	-	4.00	-	V	
		6.0	5.50	5.9	-	5.50	-		
		3.0	V <sub>IN</sub> = GND I <sub>OH</sub> = -1.3 mA I <sub>OH</sub> = -2.0 mA I <sub>OH</sub> = -2.6 mA	2.68	2.82	-	2.63		-
		4.5		4.18	4.33	-	4.13		-
6.0	5.68	5.76		-	5.63	-			
V <sub>OL</sub>	LOW Level Output Voltage	2.0	I <sub>OL</sub> = 20 μA V <sub>IN</sub> = V <sub>IH</sub>	-	0.00	0.20	-	0.20	V
		3.0		-	0.00	0.50	-	0.50	
		4.5		-	0.01	0.50	-	0.50	
		6.0		-	0.04	0.50	-	0.50	
		3.0	V <sub>IN</sub> = V <sub>CC</sub> I <sub>OL</sub> = 1.3 mA I <sub>OL</sub> = 2.0 mA I <sub>OL</sub> = 2.6 mA	-	0.11	0.26	-	0.33	V
		4.5		-	0.12	0.26	-	0.33	
		6.0		-	0.15	0.26	-	0.33	
I <sub>IN</sub>	Input Leakage Current	6.0	V <sub>IN</sub> = V <sub>CC</sub> , GND	-	-	±0.1	-	±1.0	μA
I <sub>CC</sub>	Quiescent Supply Current	6.0	V <sub>IN</sub> = V <sub>CC</sub> , GND	-	-	1.0	-	10.0	μA

AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40 to +85°C		Unit
				Min	Typ	Max	Min	Max	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay (Figure 4, 6)	5.0	C <sub>L</sub> = 15 pF	-	3	15	-	-	ns
		2.0	C <sub>L</sub> = 50 pF	-	17	100	-	125	ns
		3.0		-	9	27	-	35	
		4.5		-	7	20	-	25	
6.0	-	6.5	17	-	21				
t <sub>TLH</sub> , t <sub>THL</sub>	Output Transition Time (Figure 4, 6)	5.0	C <sub>L</sub> = 15 pF	-	4	10	-	-	ns
		2.0	C <sub>L</sub> = 50 pF	-	25	125	-	155	ns
		3.0		-	16	35	-	45	
		4.5		-	12	25	-	31	
6.0	-	10	21	-	26				
C <sub>IN</sub>	Input Capacitance	Open		-	2	10	-	10	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Figure 5)	5.0	(Note 2)	-	4	-	-	-	pF

2. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I<sub>CCD</sub>) at no output loading and operating at 50% duty cycle. C<sub>PD</sub> is related to I<sub>CCD</sub> dynamic operating current by the expression:  
 $I_{CCD} = (C_{PD})(V_{CC})(f_{IN}) + (I_{CCstatic})$ .

AC Loading and Waveforms



C<sub>L</sub> includes load and stray capacitance  
 Input PRR = 1.0 MHz; t<sub>W</sub> = 500 ns

Figure 4. AC Test Circuit

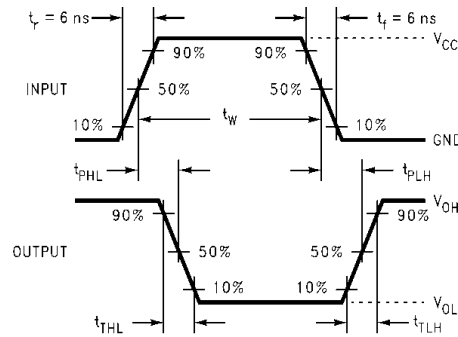
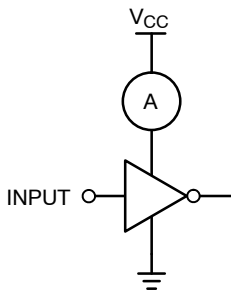


Figure 6. AC Waveforms



Input = AC Waveform;  
 PRR = Variable; Duty Cycle = 50%.

Figure 5. I<sub>CCD</sub> Test Circuit

# NC7SU04

## ORDERING INFORMATION

Order Number	Top Mark	Package Description	Shipping†
NC7SU04M5X	7SU4	SC-74A	3000 / Tape & Reel
NC7SU04M5X-L22090	7SU4	SOT23-5	3000 / Tape & Reel
NC7SU04P5X	SU4	SC-88A	3000 / Tape & Reel
NC7SU04P5X-L22057	SU4	SC-88A	3000 / Tape & Reel
NC7SU04L6X	E5	SIP6, MicroPak	5000 / Tape & Reel
NC7SU04L6X-L22175	E5	SIP6, MicroPak	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.

# 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

ON Semiconductor®



SCALE 2:1

### SC-74A CASE 318BQ ISSUE B

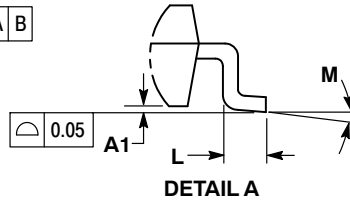
DATE 18 JAN 2018



TOP VIEW



SIDE VIEW



DETAIL A



END VIEW

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.

DIM	MILLIMETERS	
	MIN	MAX
A	0.90	1.10
A1	0.01	0.10
b	0.25	0.50
c	0.10	0.26
D	2.85	3.15
E	2.50	3.00
E1	1.35	1.65
e	0.95 BSC	
L	0.20	0.60
M	0°	10°

#### RECOMMENDED SOLDERING FOOTPRINT\*



#### 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.

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

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 2:1

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 1<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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