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 μA
- 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

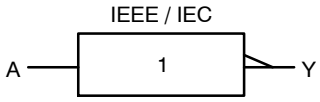
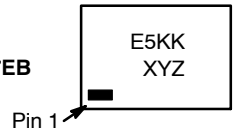


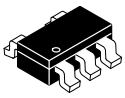
Figure 1. Logic Symbol

MARKING DIAGRAMS

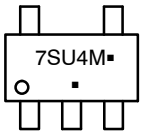


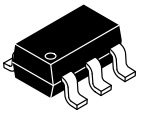
SIP6
CASE 127EB



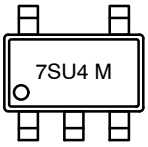


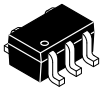
SC−74A
CASE 318BQ



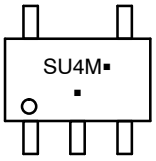


SOT23−5
CASE 527AH





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.

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Pin Configurations

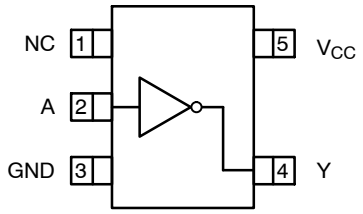


Figure 2. SOT23−5, SC−88A and SC−74A (Top View)

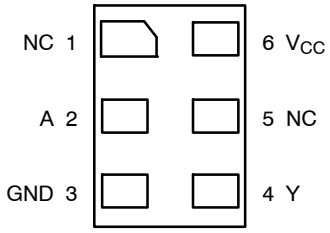


Figure 3. MicroPak (Top Through View)

PIN DESCRIPTIONS

Pin Name	Description
A	Input
Y	Output
NC	No Connect

FUNCTION TABLE ($Y = \overline{A}$)

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_{CC}	Supply Voltage		−0.5	6.5	V
I_{IK}	DC Input Diode Current	V_{IN} < 0 V	−	−20	mA
		V_{IN} > V_{CC}	−	+20	
V_{IN}	DC Input Voltage		−0.5	V_{CC} + 0.5	V
I_{OK}	DC Output Diode Current	V_{OUT} < 0 V	−	−20	mA
		V_{OUT} > V_{CC}	−	+20	
V_{OUT}	DC Output Voltage		−0.5	V_{CC} + 0.5	V
I_{OUT}	DC Output Source or Sink Current		−	±12.5	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current per Output Pin		−	±25	mA
T_{STG}	Storage Temperature		−65	+150	°C
T_J	Junction Temperature		−	+150	°C
T_L	Lead Temperature (Soldering, 10 Seconds)		−	+260	°C
P_D	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.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	Supply Voltage		2.0	6.0	V
V_{IN}	Input Voltage		0	V_{CC}	V
V_{OUT}	Output Voltage		0	V_{CC}	V
T_A	Operating Temperature		−40	+85	°C
θ_{JA}	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 ELECTICAL CHARACTERISTICS

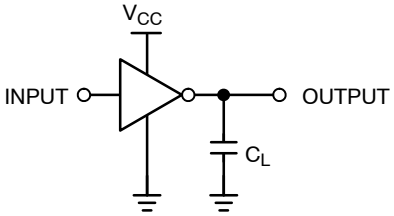
Symbol	Parameter	V_{CC} (V)	Conditions	T_A = +25°C			T_A = −40 to +85°C		Unit
				Min	Typ	Max	Min	Max	
V_{IH}	HIGH Level Input Voltage	2.0 3.0 4.5 6.0		1.70 2.45 3.60 4.80	– – – –	– – – –	1.70 2.45 3.60 4.80	– – – –	V
V_{IL}	LOW Level Input Voltage	2.0 3.0 4.5 6.0		– – – –	– – – –	0.30 0.50 0.90 1.20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

AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	V_{CC} (V)	Conditions	T_A = +25°C			T_A = −40 to +85°C		Unit
				Min	Typ	Max	Min	Max	
t_{PLH}, t_{PHL}	Propagation Delay (Figure 4, 6)	5.0	C_L = 15 pF	–	3	15	–	–	ns
		2.0 3.0 4.5 6.0	C_L = 50 pF	– – – –	17 9 7 6.5	100 27 20 17	– – – –	125 35 25 21	ns
t_{TLH}, t_{THL}	Output Transition Time (Figure 4, 6)	5.0	C_L = 15 pF	–	4	10	–	–	ns
		2.0 3.0 4.5 6.0	C_L = 50 pF	– – – –	25 16 12 10	125 35 25 21	– – – –	155 45 31 26	ns
C_{IN}	Input Capacitance	Open		–	2	10	–	10	pF
C_{PD}	Power Dissipation Capacitance (Figure 5)	5.0	(Note 2)	–	4	–	–	–	pF

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

AC Loading and Waveforms



C_L includes load and stray capacitance
Input PRR = 1.0 MHz; t_W = 500 ns

Figure 4. AC Test Circuit

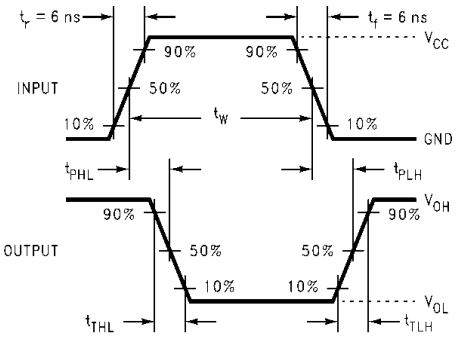
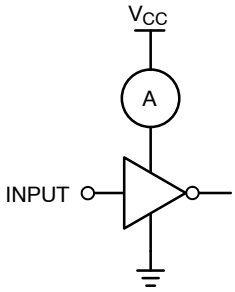


Figure 6. AC Waveforms



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

Figure 5. I_{CCD} Test Circuit

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

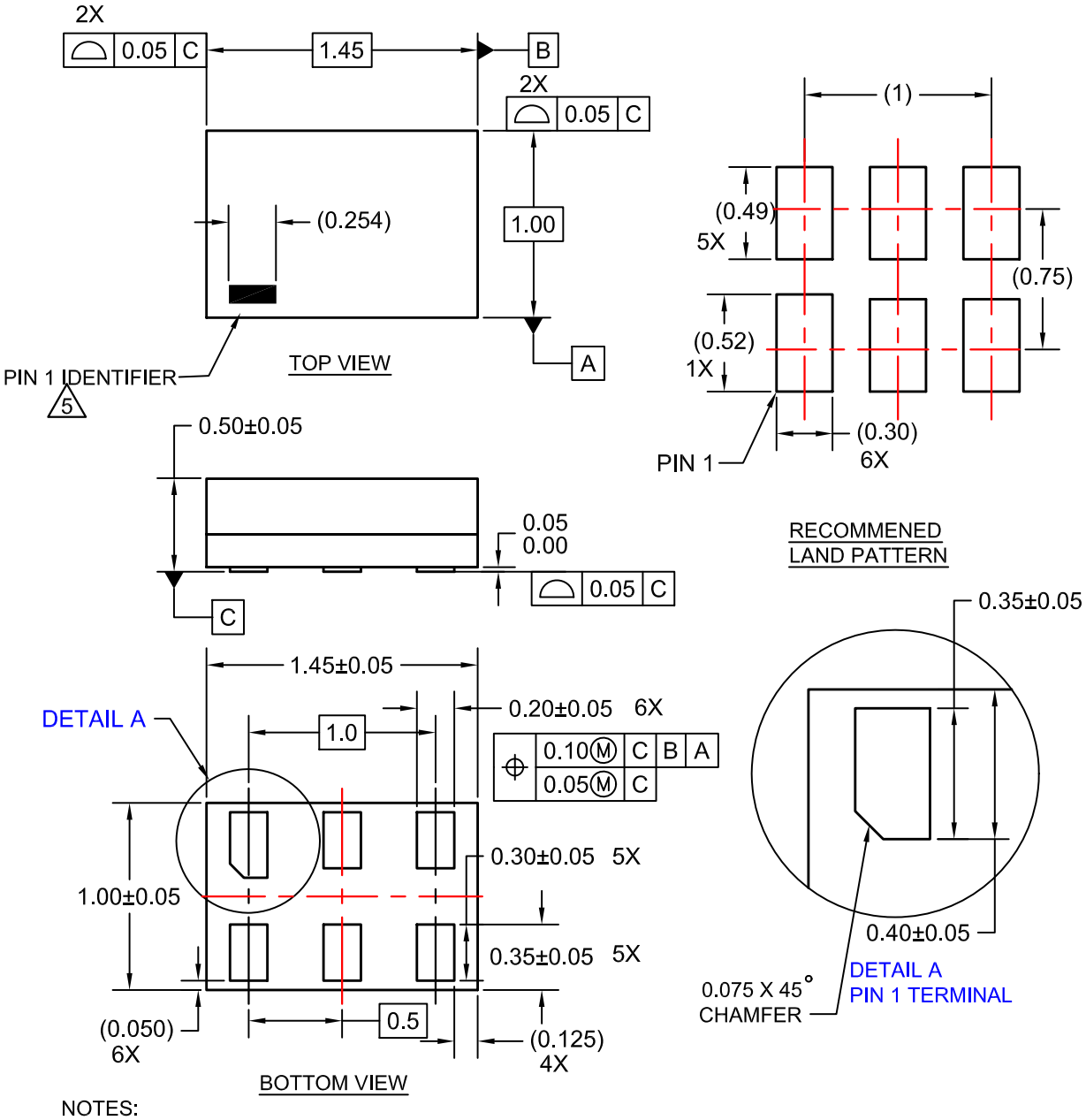
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

SIP6 1.45X1.0
CASE 127EB
ISSUE O

DATE 31 AUG 2016



NOTES:

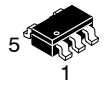
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2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-2009
4. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY OTHER LINE IN THE MARK CODE LAYOUT.

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DESCRIPTION:	**SIP6 1.45X1.0**	**PAGE 1 OF 1**

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MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

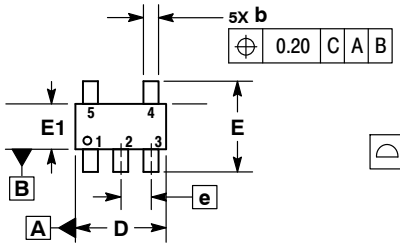
ON Semiconductor®

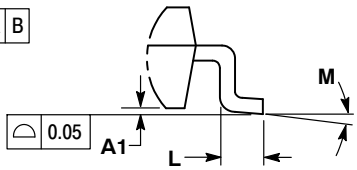


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SC−74A
CASE 318BQ
ISSUE B

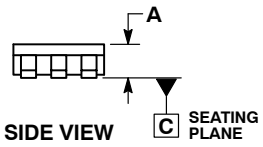
DATE 18 JAN 2018

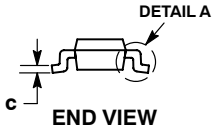




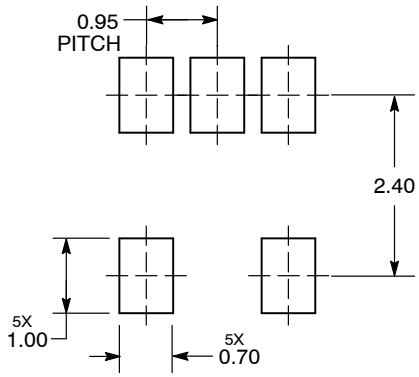
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2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH,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

	MILLIMETERS	
DIM	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 °





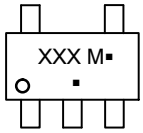
RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

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

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.

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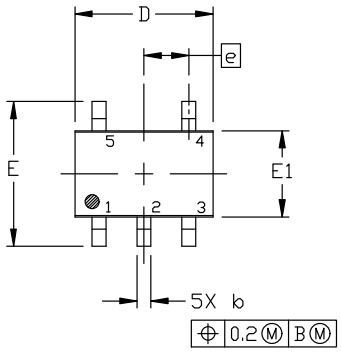
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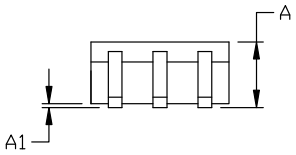
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

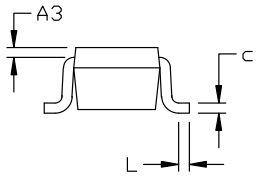
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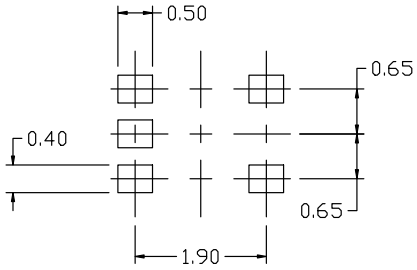
SC−88A (SC−70−5/SOT−353)
CASE 419A−02
ISSUE M

DATE 11 APR 2023









RECOMMENDED
MOUNTING FOOTPRINT

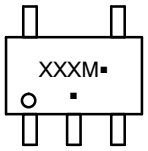
* For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. 419A−01 OBSOLETE. NEW STANDARD 419A−02
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.1016MM PER SIDE.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.80	0.95	1.10
A1	---	---	0.10
A3	0.20 REF		
b	0.10	0.20	0.30
c	0.10	---	0.25
D	1.80	2.00	2.20
E	2.00	2.10	2.20
E1	1.15	1.25	1.35
e	0.65 BSC		
L	0.10	0.15	0.30

GENERIC MARKING DIAGRAM*



*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.

XXX = Specific Device Code
M = Date Code
▪ = Pb−Free Package

(Note: Microdot may be in either location)

STYLE 1:
PIN 1. BASE
2. EMITTER
3. BASE
4. COLLECTOR
5. COLLECTOR

STYLE 2:
PIN 1. ANODE
2. EMITTER
3. BASE
4. COLLECTOR
5. CATHODE

STYLE 3:
PIN 1. ANODE 1
2. N/C
3. ANODE 2
4. CATHODE 2
5. CATHODE 1

STYLE 4:
PIN 1. SOURCE 1
2. DRAIN 1/2
3. SOURCE 1
4. GATE 1
5. GATE 2

STYLE 5:
PIN 1. CATHODE
2. COMMON ANODE
3. CATHODE 2
4. CATHODE 3
5. CATHODE 4

STYLE 6:
PIN 1. EMITTER 2
2. BASE 2
3. EMITTER 1
4. COLLECTOR
5. COLLECTOR 2/BASE 1

STYLE 7:
PIN 1. BASE
2. EMITTER
3. BASE
4. COLLECTOR
5. COLLECTOR

STYLE 8:
PIN 1. CATHODE
2. COLLECTOR
3. N/C
4. BASE
5. EMITTER

STYLE 9:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. ANODE
5. ANODE

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.

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