FAIRCHILD SEMICONDUCTOR™

June 1996
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NC7S04
TinyLogic™ HS Inverter

General Description

The NC7S04 is a single high performance CMOS Inverter. 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. Three stages of gain between input and output assures high noise immunity and reduced sensitivity to input edge rate.

Features

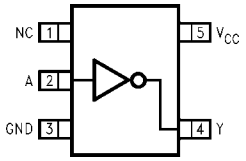
- Space saving SOT23 or SC70 5-lead package
- High Speed: t_{PD} = 3 ns typ
- Low Quiescent Power: I_{CC} < 1 µA
- Balanced Output Drive: 2 mA I_{OL}, −2 mA I_{OH}
- Broad V_{CC} Operating Range: 2V – 6V
- Balanced Propagation Delays
- Specified for 3V operation

Ordering Code:

Order Number	Package Number	Product Code Top Mark	Package Description	Supplied As
NC7S04M5	MA05B	7S04	5-Lead SOT23, JEDEC MO-178, 1.6mm	250 Units On Tape and Reel
NC7S04M5X	MA05B	7S04	5-Lead SOT23, JEDEC MO-178, 1.6mm	3k Units on Tape and Reel
NC7S04P5	MAA05A	S04	5-Lead SC70, EIAJ SC-88a, 1.25mm Wide	250 Units On Tape and Reel
NC7S04P5X	MAA05A	S04	5-Lead SC70, EIAJ SC-88a, 1.25mm Wide	3k Units on Tape and Reel

Logic Symbol

Connection Diagram



(Top View)

Pin Descriptions

Pin Names	Description
A	Input
Y	Output
NC	No Connect

Function Table

$Y = \overline{A}$

Input	Output
A	Y
L	H
H	L

H = HIGH Logic Level
L = LOW Logic Level

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Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Diode Current (I_{IK})	
@$V_{IN} \le -0.5V$	−20 mA
@$V_{IN} \ge V_{CC} + 0.5V$	+20 mA
DC Input Voltage (V_{IN})	−0.5V to V_{CC} +0.5V
DC Output Diode Current (I_{OK})	
@$V_{OUT} \le -0.5V$	−20 mA
@$V_{OUT} \ge V_{CC} + 0.5V$	+20 mA
DC Output Voltage (V_{OUT})	−0.5V to V_{CC} +0.5V
DC Output Source or Sink Current (I_{OUT})	±12.5 mA
DC V_{CC} or Ground Current per Output Pin (I_{CC} or I_{GND})	±25 mA
Storage Temperature (T_{STG})	−65°C to +150°C
Junction Temperature (T_J)	150°C
Lead Temperature (T_L) (Soldering, 10 seconds)	260°C
Power Dissipation (P_D) @ +85°C	
SOT23-5	200 mW
SC70-5	150 mW

Recommended Operating Conditions (Note 2)

Supply Voltage (V_{CC})	2.0V to 6.0V
Input Voltage (V_{IN})	0V to V_{CC}
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_A)	−40°C to +85°C
Input Rise and Fall Time (t_r, t_f)	
V_{CC} @ 2.0V	0 to 1000 ns
V_{CC} @ 3.0V	0 to 750 ns
V_{CC} @ 4.5V	0 to 500 ns
V_{CC} @ 6.0V	0 to 400 ns
Thermal Resistance (θ_{JA})	
SOT23-5	300°C/W
SC70-5	425°C/W

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation of circuits outside the databook specifications.

Note 2: Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

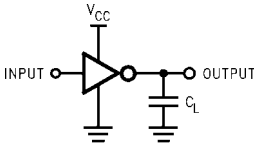
Symbol	Parameter	V_{CC}	$T_A = +25°C$			$T_A = -40°C$ to $+85°C$		Units	Conditions
		(V)	Min	Typ	Max	Min	Max		
V_{IH}	HIGH Level Input Voltage	2.0	1.50			1.50		V	
		3.0–6.0	0.7 V_{CC}			0.7 V_{CC}			
V_{IL}	LOW Level Input Voltage	2.0			0.50		0.50	V	
		3.0–6.0			0.3 V_{CC}		0.3 V_{CC}		
V_{OH}	HIGH Level Output Voltage	2.0	1.90	2.0		1.90		V	$I_{OH} = -20$ µA $V_{IN} = V_{IL}$
		3.0	2.90	3.0		2.90			
		4.5	4.40	4.5		4.40			
		6.0	5.90	6.0		5.90			
								V	$V_{IN} = V_{IL}$
		3.0	2.68	2.85		2.63			$I_{OH} = -1.3$ mA
		4.5	4.18	4.35		4.13			$I_{OH} = -2$ mA
		6.0	5.68	5.85		5.63			$I_{OH} = -2.6$ mA
V_{OL}	LOW Level Output Voltage	2.0		0.0	0.10		0.10	V	$I_{OL} = 20$ µA $V_{IN} = V_{IH}$
		3.0		0.0	0.10		0.10		
		4.5		0.0	0.10		0.10		
		6.0		0.0	0.10		0.10		
								V	$V_{IN} = V_{IH}$
		3.0		0.1	0.26		0.33		$I_{OL} = 1.3$ mA
		4.5		0.1	0.26		0.33		$I_{OL} = 2$ mA
		6.0		0.1	0.26		0.33		$I_{OL} = 2.6$ mA
I_{IN}	Input Leakage Current	6.0			±0.1		±1.0	µA	$V_{IN} = V_{CC}$,GND
I_{CC}	Quiescent Supply Current	6.0			1.0		10.0	µA	$V_{IN} = V_{CC}$, GND

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	$T_A = +25°C$			$T_A = -40°C$ to $+85°C$		Units	Conditions	Fig. No.
			Min	Typ	Max	Min	Max			
t_{PLH}, t_{PHL}	Propagation Delay	5.0		3	15			ns	$C_L = 15$ pF	Figures 1, 3
		2.0		18	100		125	ns	$C_L = 50$ pF	
		3.0		10	27		35			
		4.5		7	20		25			
		6.0		6	17		21			
t_{TLH}, t_{THL}	Output Transition Time	5.0		3	10			ns	$C_L = 15$ pF	Figures 1, 3
		2.0		25	125		155	ns	$C_L = 50$ pF	
		3.0		16	35		45			
		4.5		11	25		31			
		6.0		9	21		26			
C_{IN}	Input Capacitance	Open		2	10		10	pF		
C_{PD}	Power Dissipation Capacitance	5.0		6				pF	(Note 3)	Figure 2

Note 3: 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. (See Figure 2.) C_{PD} is related to I_{CCD} dynamic operating current by the expression: $I_{CCD} = (C_{PD})(V_{CC})(f_{IN}) + (I_{CC}\text{static})$.

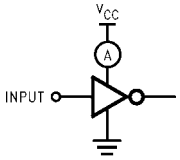
AC Loading and Waveforms



C_L includes load and stray capacitance

Input PRR = 1.0 MHz, t_w = 500 ns

FIGURE 1. AC Test Circuit



Input = AC Waveforms;

PRR = Variable; Duty Cycle = 50%

FIGURE 2. I_{CCD} Test Circuit

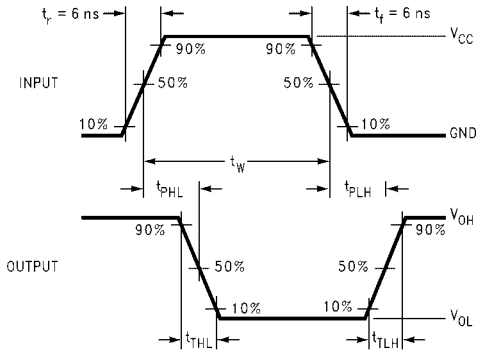


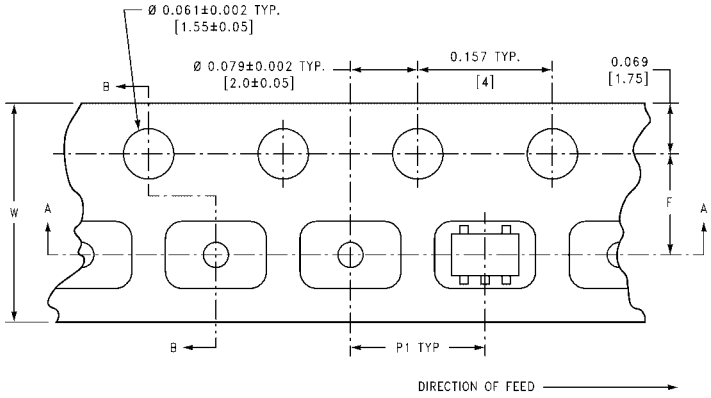
FIGURE 3. AC Waveforms

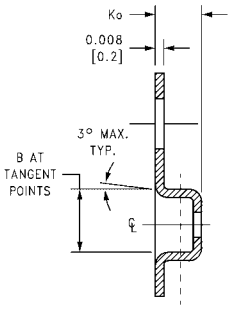
Tape and Reel Specification

TAPE FORMAT

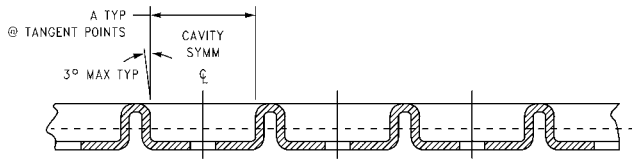
Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
M5, P5	Leader (Start End)	125 (typ)	Empty	Sealed
	Carrier	250	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed
M5X, P5X	Leader (Start End)	125 (typ)	Empty	Sealed
	Carrier	3000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed

TAPE DIMENSIONS inches (millimeters)

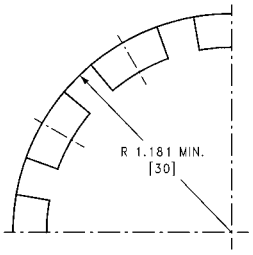




SECTION B-B



SECTION A-A

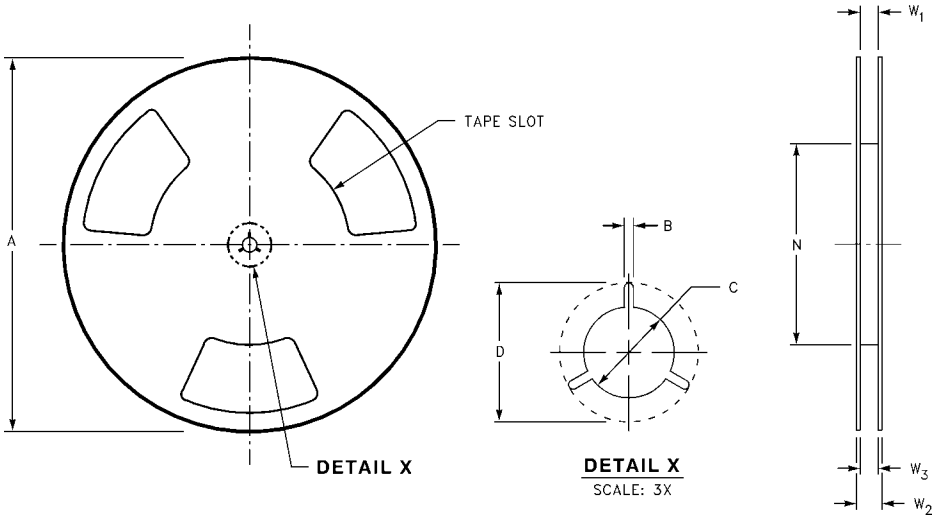


BEND RADIUS NOT TO SCALE

Package	Tape Size	DIM A	DIM B	DIM F	DIM K_o	DIM P1	DIM W
SC70-5	8 mm	0.093 (2.35)	0.096 (2.45)	0.138 ± 0.004 (3.5 ± 0.10)	0.053 ± 0.004 (1.35 ± 0.10)	0.157 (4)	0.315 ± 0.004 (8 ± 0.1)
SOT23-5	8 mm	0.130 (3.3)	0.130 (3.3)	0.138 ± 0.002 (3.5 ± 0.05)	0.055 ± 0.004 (1.4 ± 0.11)	0.157 (4)	0.315 ± 0.012 (8 ± 0.3)

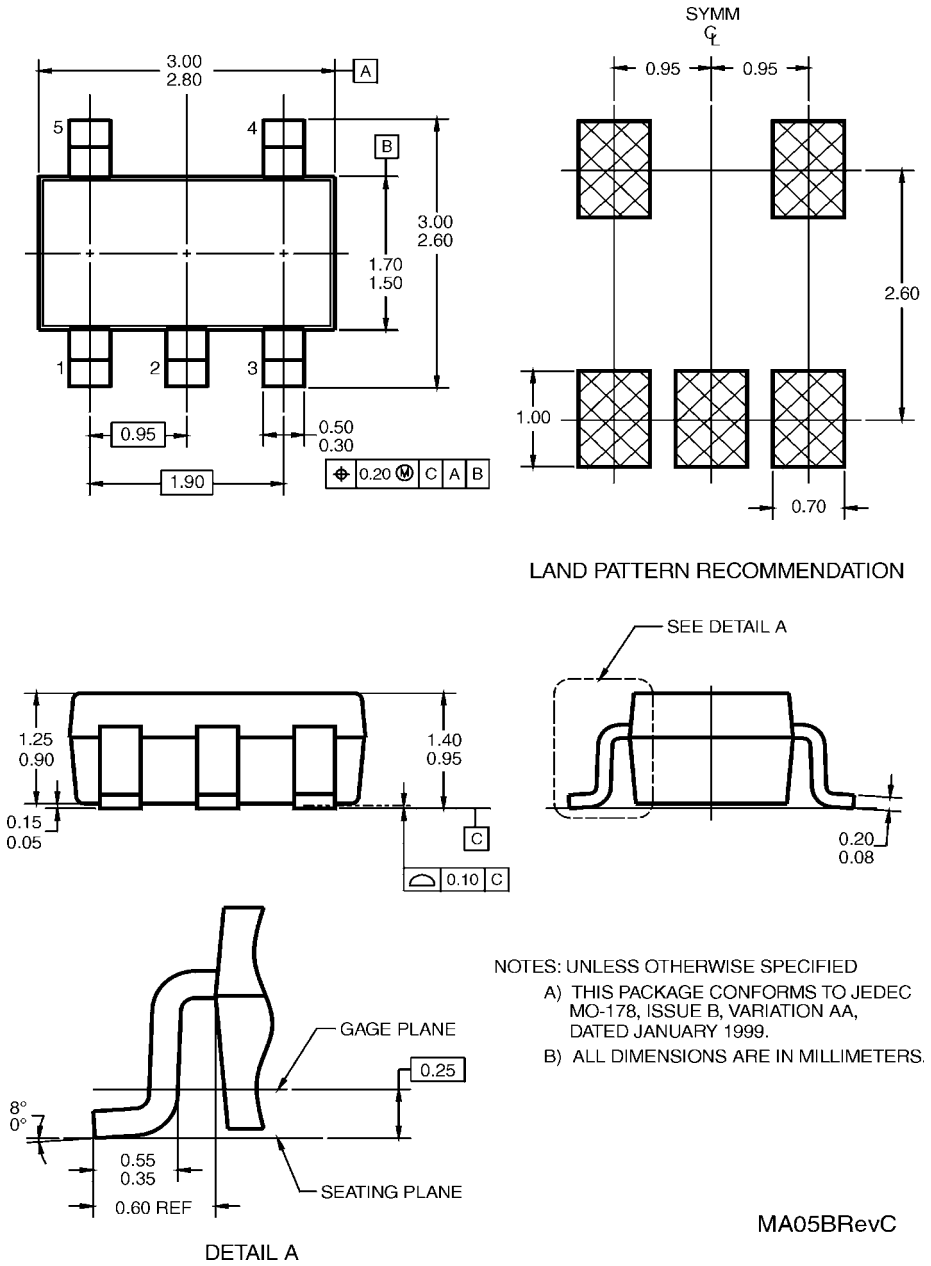
Tape and Reel Specification (Continued)

REEL DIMENSIONS inches (millimeters)



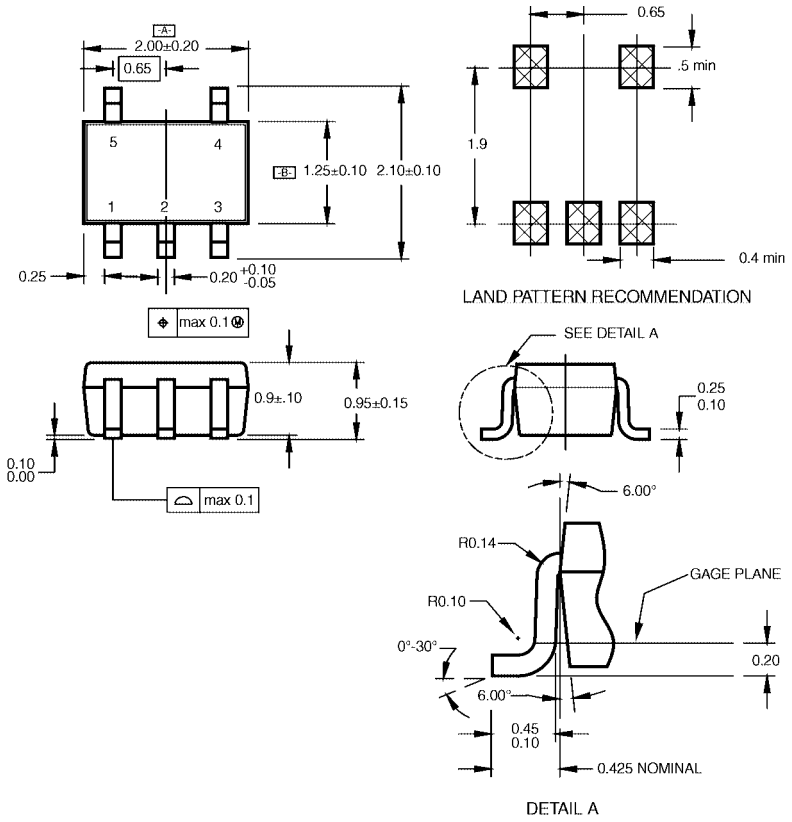
Tape Size	A	B	C	D	N	W1	W2	W3
8 mm	7.0 (177.8)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.331 + 0.059/–0.000 (8.40 + 1.50/–0.00)	0.567 (14.40)	W1 + 0.078/–0.039 (W1 + 2.00/–1.00)

Physical Dimensions inches (millimeters) unless otherwise noted



5-Lead SOT23, JEDEC MO-178, 1.6mm
Package Number MA05B

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



NOTES:

A. CONFORMS TO EIAJ REGISTERED OUTLINE DRAWING SC88A.
B. DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH.
C. DIMENSIONS ARE IN MILLIMETERS.

MAA05ARevC

5-Lead SC70, EIAJ SC-88a, 1.25mm Wide
Package Number MAA05A

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