FAIRCHILD SEMICONDUCTOR™

October 1996
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NC7SZU04
TinyLogic® UHS Unbuffered Inverter

General Description

The NC7SZU04 is a single unbuffered inverter from Fairchild's Ultra High Speed Series of TinyLogic®. The special purpose unbuffered circuit design is primarily intended for crystal oscillator or analog applications. The device is fabricated with advanced CMOS technology to achieve ultra high speed with high output drive while maintaining low static power dissipation over a very broad V_{CC} operating range. The device is specified to operate over the 1.65V to 5.5V V_{CC} range.

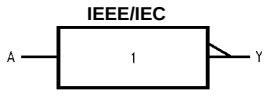
Features

- Space saving SOT23 or SC70 5-lead package
- Ultra small MicroPak™ leadless package
- Unbuffered for crystal oscillator and analog applications
- Balanced Output Drive; ± 16 mA at 4.5V V_{CC}
- Broad V_{CC} Operating Range; 1.65V–5.5V
- Low Quiescent Power;
  I_{CC} < 2 µA, V_{CC} = 5.5V, T_A = 25°C

Ordering Code:

Order Number	Package Number	Product Code Top Mark	Package Description	Supplied As
NC7SZU04M5X	MA05B	7ZU4	5-Lead SOT23, JEDEC MO-178, 1.6mm	3k Units on Tape and Reel
NC7SZU04P5X	MAA05A	ZU4	5-Lead SC70, EIAJ SC-88a, 1.25mm Wide	3k Units on Tape and Reel
NC7SZU04L6X	MAC06A	C5	6-Lead MicroPak, 1.0mm Wide	5k Units on Tape and Reel

Logic Symbol



Pin Descriptions

Pin Names	Description
A	Input
Y	Output
NC	No Connect

Function Table

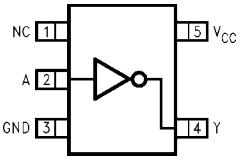
$Y = \overline{A}$

Input	Output
A	Y
L	H
H	L

H = HIGH Logic Level
L = LOW Logic Level

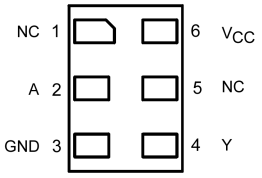
Connection Diagrams

Pin Assignments for SOT23 and SC70



(Top View)

Pad Assignments for MicroPak



(Top Thru View)

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MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC})	−0.5V to +6V
DC Input Voltage (V_{IN})	−0.5V to +6V
DC Output Voltage (V_{OUT})	−0.5V to +6V
DC Input Diode Current (I_{IK})	
@ V_{IN} < −0.5V	−50 mA
@ V_{IN} > V_{CC} + 0.5V	+20 mA
DC Output Diode Current (I_{OK})	
@ V_{OUT} < −0.5V	−50 mA
@ V_{OUT} > 0.5V, V_{CC} = GND	+50 mA
DC Output Current (I_{OUT})	±50 mA
DC V_{CC}/GND Current (I_{CC}/I_{GND})	±100 mA
Storage Temperature (T_{STG})	−65°C to +150°C
Junction Temperature under Bias (T_J)	150°C
Junction 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 Operating (V_{CC})	1.65V to 5.5V
Supply Voltage Data Retention (V_{CC})	1.5V to 5.5V
Input Voltage (V_{IN})	0V to 5.5V
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_A)	−40°C to +85°C
Thermal Resistance (θ_{JA})	
SOT23-5	300°C/W
SC70-5	425°C/W

Note 1: Absolute maximum ratings are DC values beyond which the device may be damaged or have its useful life impaired. The datasheet 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 outside datasheet specifications.

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

DC Electrical Characteristics

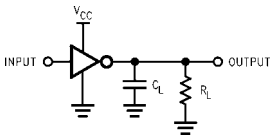
Symbol	Parameter	V_{CC} (V)	T_A = +25°C			T_A = −40°C to +85°C		Units	Conditions	
			Min	Typ	Max	Min	Max			
V_{IH}	HIGH Level Input Voltage	1.8 to 2.7	0.85 V_{CC}			0.85 V_{CC}		V		
		3.0 to 5.5	0.8 V_{CC}			0.8 V_{CC}				
V_{IL}	LOW Level Input Voltage	1.8 to 2.7			0.15 V_{CC}		0.15 V_{CC}	V		
		3.0 to 5.5			0.2 V_{CC}		0.2 V_{CC}			
V_{OH}	HIGH Level Output Voltage	1.65	1.55	1.65		1.55				
		1.8	1.6	1.8		1.6				
		2.3	2.1	2.3		2.1		V	V_{IN} = V_{IL}	I_{OH} = −100 µA
		3.0	2.7	3.0		2.7				
		4.5	4.0	4.4		4.0				
		1.65	1.29	1.52		1.29				I_{OH} = −4 mA
		2.3	1.9	2.14		1.9				I_{OH} = −4 mA
		3.0	2.4	2.75		2.4		V	V_{IN} = GND	I_{OH} = −8 mA
		3.0	2.3	2.61		2.3				I_{OH} = −12 mA
		4.5	3.8	4.13		3.8				I_{OH} = −16 mA
V_{OL}	LOW Level Output Voltage	1.65		0.0	0.1		0.1			
		1.8		0.0	0.2		0.2			
		2.3		0.0	0.2		0.2	V	V_{IN} = V_{IH}	I_{OL} = 100 µA
		3.0		0.0	0.3		0.3			
		4.5		0.0	0.5		0.5			
		1.65		0.08	0.24		0.24			I_{OL} = 4 mA
		2.3		0.10	0.3		0.3			I_{OL} = 4 mA
		3.0		0.17	0.4		0.4	V	V_{IN} = V_{CC}	I_{OL} = 8 mA
		3.0		0.25	0.55		0.55			I_{OL} = 12 mA
		4.5		0.26	0.55		0.55			I_{OL} = 16 mA
I_{IN}	Input Leakage Current	0 to 5.5			±1		±10	µA	V_{IN} = 5.5V, GND	
I_{CC}	Quiescent Supply Current	1.65 to 5.5			2.0		20	µA	V_{IN} = 5.5V, GND	
I_{CCPEAK}	Peak Supply Current in	1.8		2					V_{OUT} = Open	
	Analog Operation	2.5		4				mA	V_{IN} = Adjust for	
		3.3		10					Peak I_{CC} Current	
		5.0		30						

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	$T_A = +25°C$			$T_A = -40°C$ to $+85°C$		Units	Conditions	Figure Number
			Min	Typ	Max	Min	Max			
t_{PLH}, t_{PHL}	Propagation Delay	1.65	1.0		11.7	1.0	12.1	ns	C_L = 15 pF, R_L = 1 MΩ	Figures 1, 3
		1.8	1.0		8.5	1.0	9.0			
		2.5 ± 0.2	0.8		6.2	0.8	6.5			
		3.3 ± 0.3	0.5		4.5	0.5	4.8			
		5.0 ± 0.5	0.5		3.9	0.5	4.1			
t_{PLH}, t_{PHL}	Propagation Delay	3.3 ± 0.3	1.0		6.0	1.0	6.5	ns	C_L = 50 pF, R_L = 500Ω	Figures 1, 3
		5.0 ± 0.5	0.8		5.0	0.8	5.5			
C_{IN}	Input Capacitance	0		4.5				pF		
C_{PD}	Power Dissipation Capacitance	3.3		6.3				pF	(Note 3)	Figure 2
		5.0		9.5						

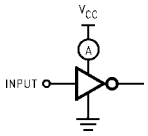
Note 3: C_{PD} is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I_{CCD}) at no output loading and operating at 50% duty cycle. (See Figure 2.) C_{PD} is related to I_{CCD} dynamic operating current by the expression:
$I_{CCD} = (C_{PD})(V_{CC})(f_{IN}) + (I_{CC}static)$.

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



Application Note: When operating the NC7SZU04's unbuffered output stage in its linear range, as in oscillator applications, care must be taken to observe maximum power rating for the device and package. The high drive nature of the design of the output stage will result in substantial simultaneous conduction currents when the stage is in the linear region. See the I_{CCPEAK} specification in the DC Electrical Characteristics table.

Input = AC Waveform; $t_r = t_f$ = 1.8 ns;
PRR = variable; Duty Cycle = 50%

FIGURE 2. I_{CCD} Test Circuit

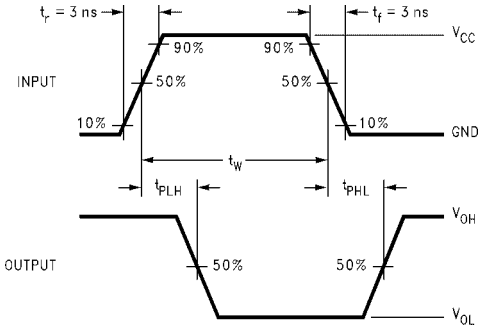


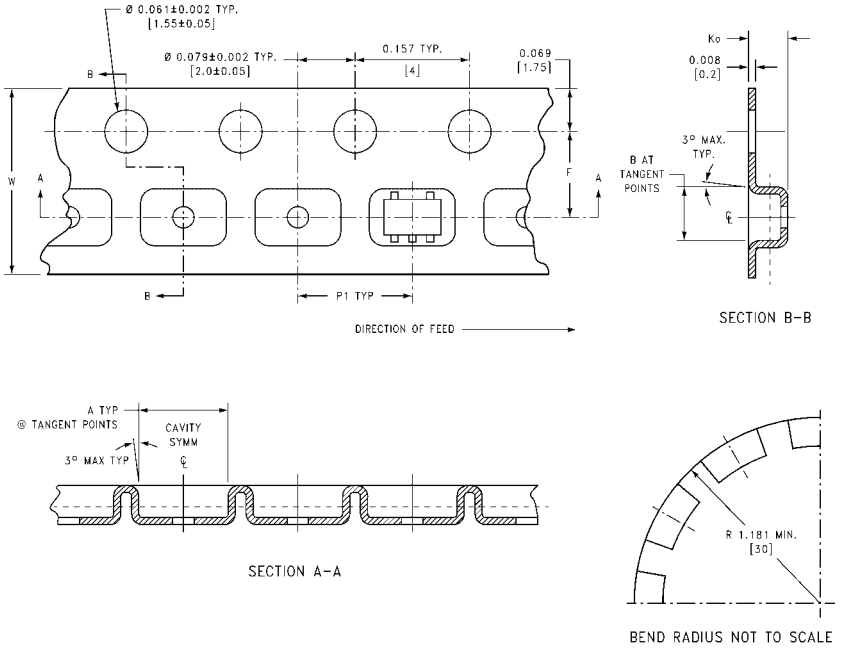
FIGURE 3. AC Waveforms

Tape and Reel Specification

TAPE FORMAT for SOT23 and SC70

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

TAPE DIMENSIONS inches (millimeters)

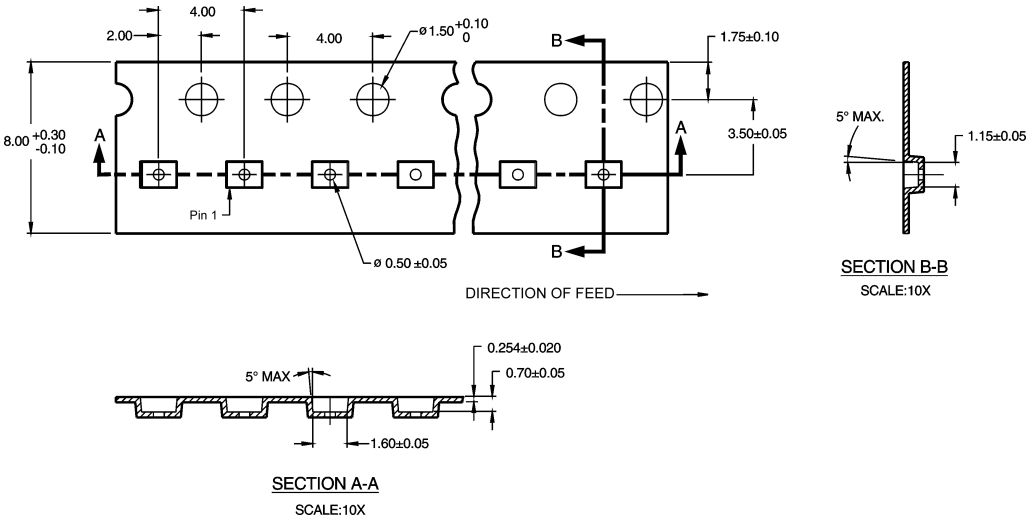


Package	Tape Size	DIM A	DIM B	DIM F	DIM K_o	DIM P1	DIM W
SC70-5	8 mm	0.093 (2.35)	0.096 (2.45)	0.138 ± 0.004 (3.5 ± 0.10)	0.053 ± 0.004 (1.35 ± 0.10)	0.157 (4)	0.315 ± 0.004 (8 ± 0.1)
SOT23-5	8 mm	0.130 (3.3)	0.130 (3.3)	0.138 ± 0.002 (3.5 ± 0.05)	0.055 ± 0.004 (1.4 ± 0.11)	0.157 (4)	0.315 ± 0.012 (8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

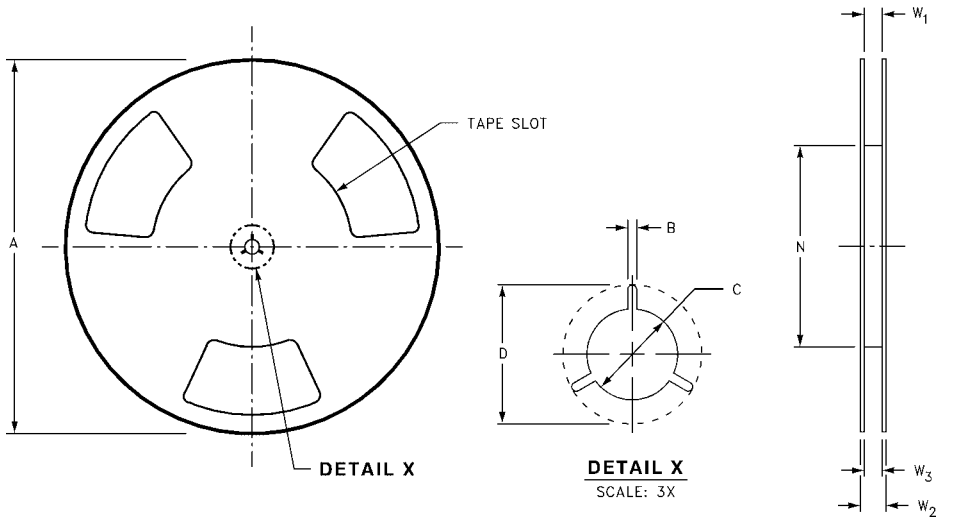
Tape and Reel Specification (Continued)

TAPE FORMAT for MicroPak

Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
L6X	Leader (Start End)	125 (typ)	Empty	Sealed
	Carrier	5000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed

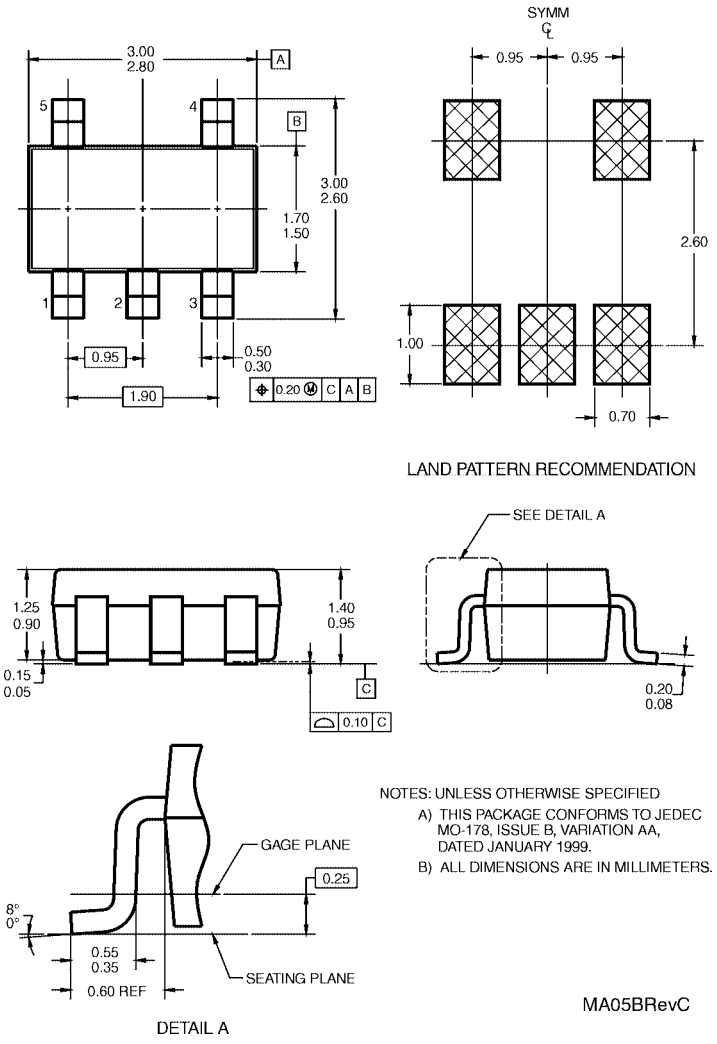


REEL DIMENSIONS inches (millimeters)



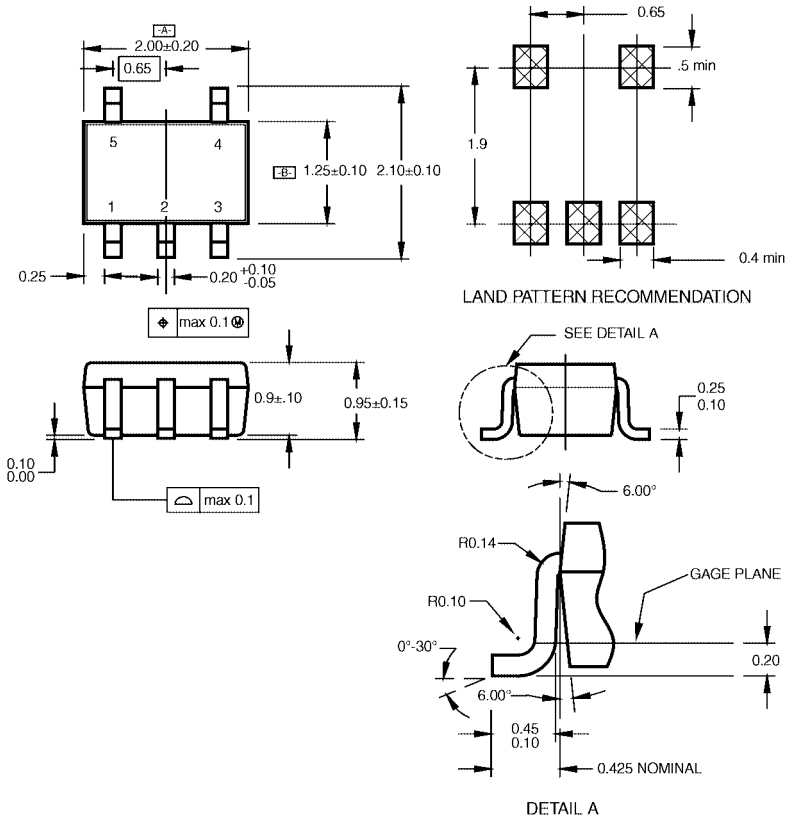
Tape Size	A	B	C	D	N	W1	W2	W3
8 mm	7.0 (177.8)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.331 + 0.059/–0.000 (8.40 + 1.50/–0.00)	0.567 (14.40)	W1 + 0.078/–0.039 (W1 + 2.00/–1.00)

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)



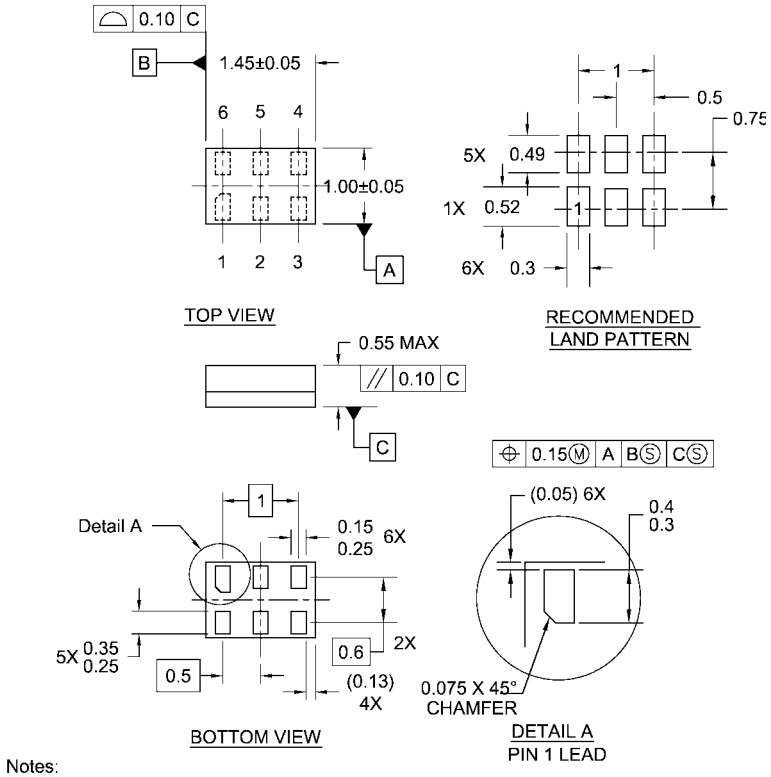
NOTES:

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

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



Notes:

1. JEDEC PACKAGE REGISTRATION IS ANTICIPATED
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-1994

MAC06ARevB

6-Lead MicroPak, 1.0mm Wide
Package Number MAC06A