FAIRCHILD SEMICONDUCTOR™

June 1996
Revised June 2000

# 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.

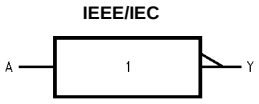
## Features

- 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

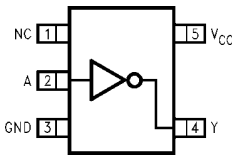
## Ordering Code:

| 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 ($\theta_{JA}$) | |
| 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

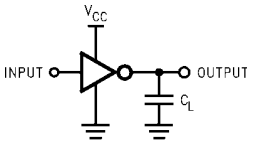
| Symbol | Parameter | $V_{CC}$ (V) | $T_A$ = +25°C | | | $T_A$ = −40°C to +85°C | | Units | Conditions |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | | |
| $V_{IH}$ | HIGH Level Input Voltage | 2.0 | 1.50 | | | 1.50 | | V | |
| | | 3.0–6.0 | 0.7 $V_{CC}$ | | | 0.7 $V_{CC}$ | | | |
| $V_{IL}$ | 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<br>$V_{IN}$ = $V_{IL}$ |
| | | 3.0 | 2.90 | 3.0 | | 2.90 | | | |
| | | 4.5 | 4.40 | 4.5 | | 4.40 | | | |
| | | 6.0 | 5.90 | 6.0 | | 5.90 | | | |
| | | 3.0 | 2.68 | 2.85 | | 2.63 | | V | $V_{IN}$ = $V_{IL}$<br>$I_{OH}$ = −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<br>$V_{IN}$ = $V_{IH}$ |
| | | 3.0 | | 0.0 | 0.10 | | 0.10 | | |
| | | 4.5 | | 0.0 | 0.10 | | 0.10 | | |
| | | 6.0 | | 0.0 | 0.10 | | 0.10 | | |
| | | 3.0 | | 0.1 | 0.26 | | 0.33 | V | $V_{IN}$ = $V_{IH}$<br>$I_{OL}$ = 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: $I_{CCD} = (C_{PD})(V_{CC})(f_{IN}) + (I_{CC}\text{static})$.

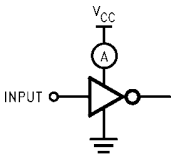
## AC Loading and Waveforms




$C_L$ 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**

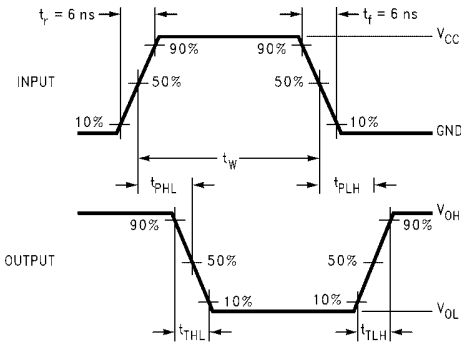


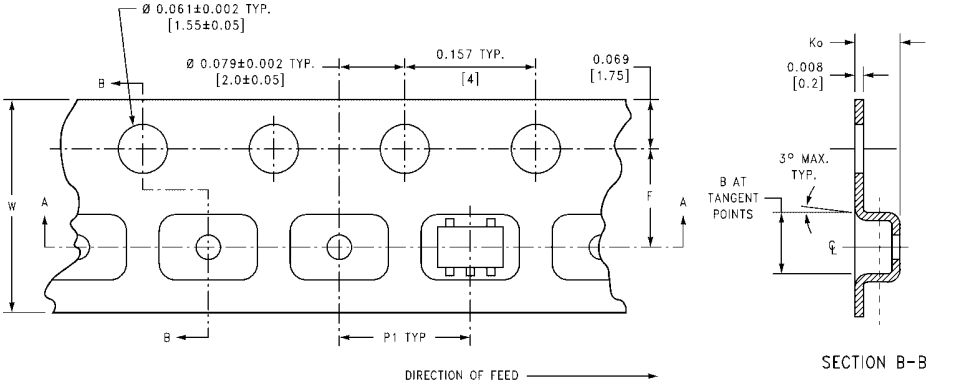

**FIGURE 3. AC Waveforms**

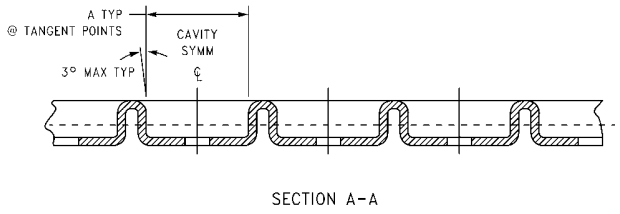
## Tape and Reel Specification

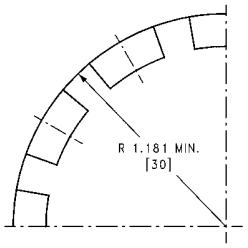
**TAPE FORMAT**

| 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)



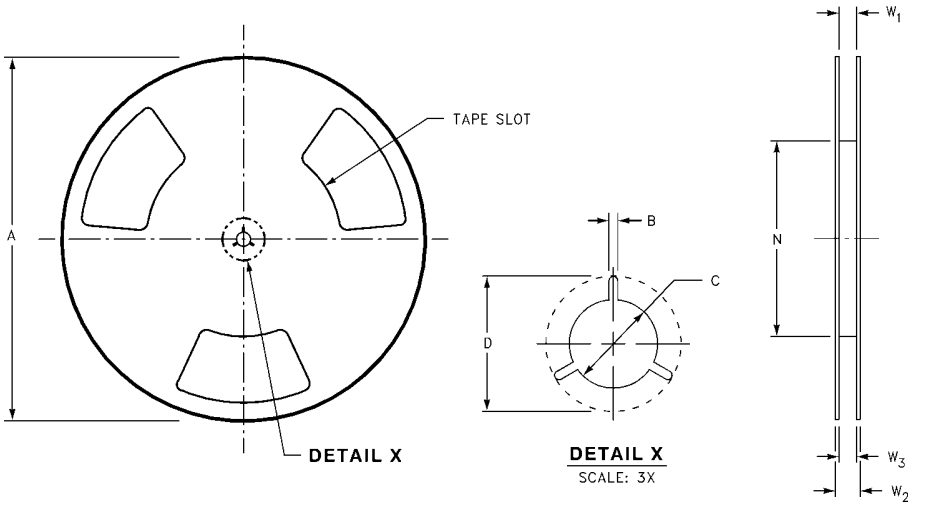




| Package | Tape Size | DIM A | DIM B | DIM F | DIM $K_o$ | DIM P1 | DIM W |
|---|---|---|---|---|---|---|---|
| SC70-5 | 8 mm | 0.093<br>(2.35) | 0.096<br>(2.45) | 0.138 ± 0.004<br>(3.5 ± 0.10) | 0.053 ± 0.004<br>(1.35 ± 0.10) | 0.157<br>(4) | 0.315 ± 0.004<br>(8 ± 0.1) |
| SOT23-5 | 8 mm | 0.130<br>(3.3)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

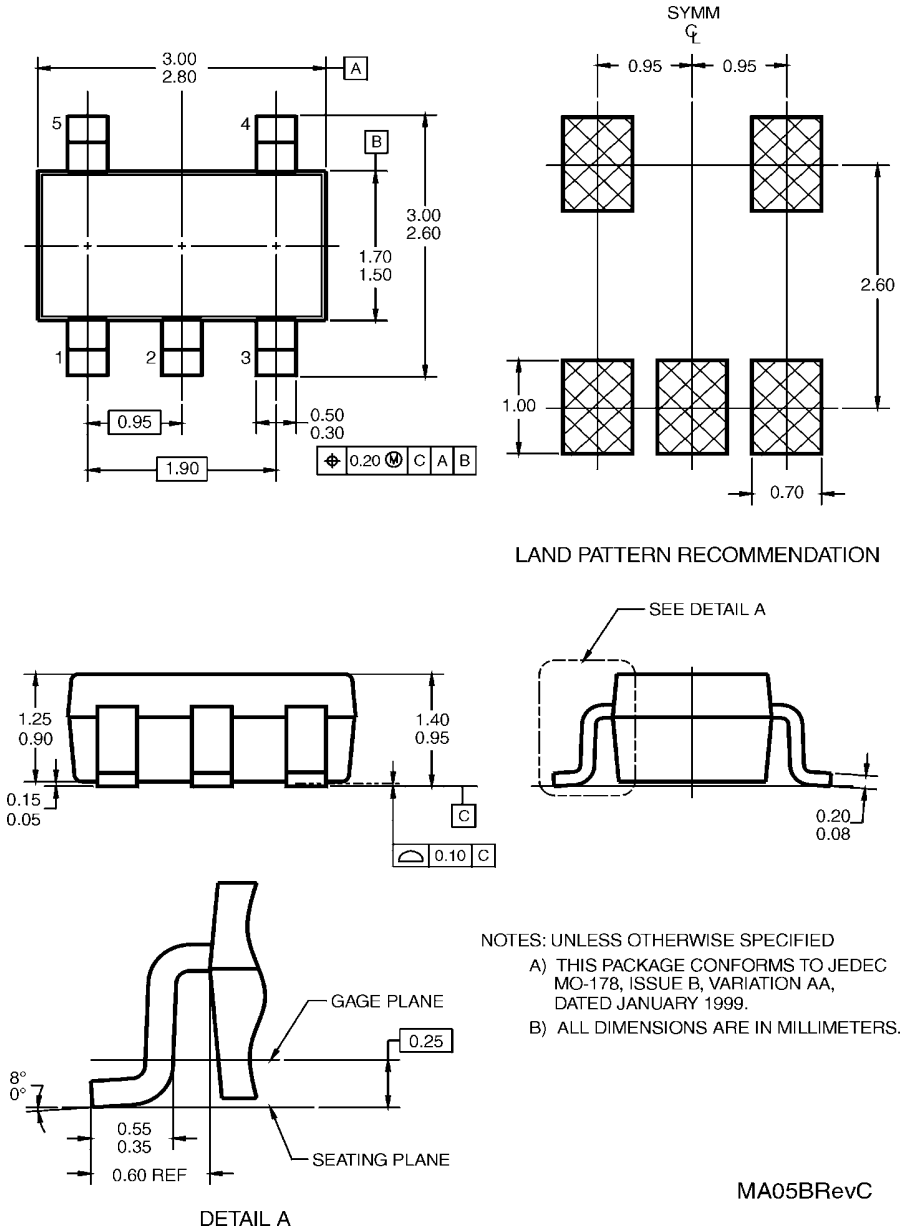
## Tape and Reel Specification (Continued)

**REEL DIMENSIONS** inches (millimeters)



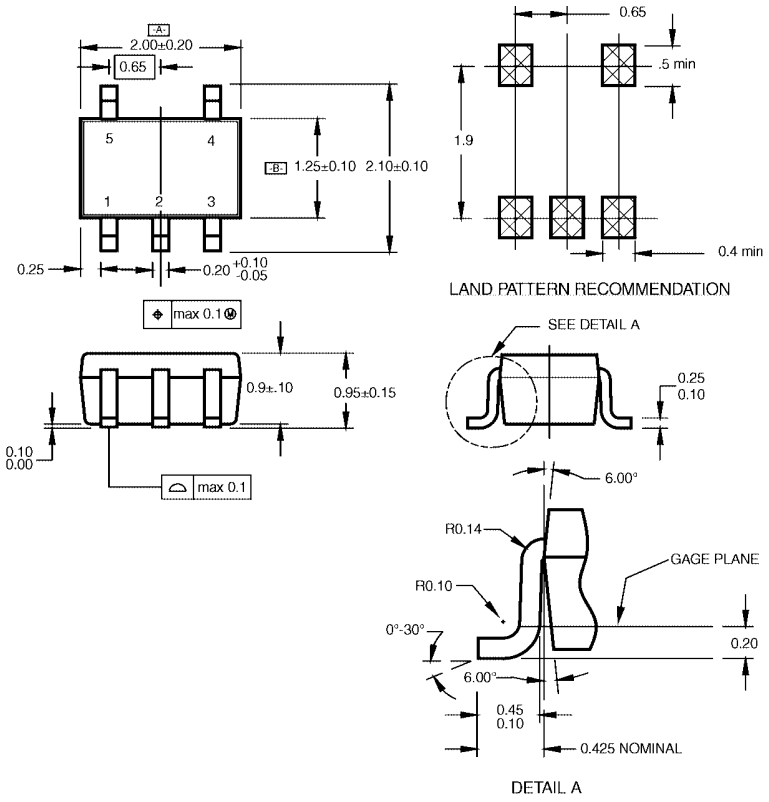

| Tape Size | A | B | C | D | N | W1 | W2 | W3 |
|---|---|---|---|---|---|---|---|---|
| 8 mm | 7.0<br>(177.8) | 0.059<br>(1.50) | 0.512<br>(13.00) | 0.795<br>(20.20) | 2.165<br>(55.00) | 0.331 + 0.059/–0.000<br>(8.40 + 1.50/–0.00) | 0.567<br>(14.40) | W1 + 0.078/–0.039<br>(W1 + 2.00/–1.00) |

## 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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