FAIRCHILD SEMICONDUCTOR™

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# NC7S00
# TinyLogic® HS 2-Input NAND Gate

## General Description

The NC7S00 is a single 2-Input high performance CMOS NAND Gate. 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 inputs and output with respect to the $V_{CC}$ and GND rails. Three stages of gain between inputs and output assures high noise immunity and reduced sensitivity to input edge rate.

## Features

- Space saving SOT23 or SC70 5-lead package
- Ultra small MicroPak™ leadless package
- High speed: $t_{PD}$ 3.5 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 |
|---|---|---|---|---|
| NC7S00M5X | MA05B | 7S00 | 5-Lead SOT23, JEDEC MO-178, 1.6mm | 3k Units on Tape and Reel |
| NC7S00P5X | MAA05A | S00 | 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3k Units on Tape and Reel |
| NC7S00L6X | MAC06A | A3 | 6-Lead MicroPak, 1.0mm Wide | 5k Units on Tape and Reel |

## Logic Symbol

**IEEE/IEC**


## Pin Descriptions

| Pin Names | Description |
|---|---|
| A, B | Input |
| Y | Output |
| NC | No Connect |

## Function Table

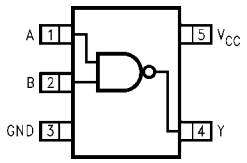
$Y = \overline{AB}$

| Inputs | | Output |
|---|---|---|
| A | B | Y |
| L | L | H |
| L | H | H |
| H | L | H |
| H | H | L |

H = HIGH Logic Level  L = LOW Logic Level

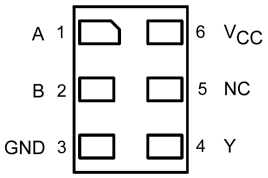
## Connection Diagrams

**Pin Assignments for SC70 and SOT23**




**(Top View)**

**Pad Assignments for MicroPak**




**(Top Thru View)**

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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 ($I_{OK}$) | |
| @$V_{OUT} < -0.5V$ | −20 mA |
| @$V_{OUT} > V_{CC} + 0.5V$ | +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–6.0V |
| Input Voltage ($V_{IN}$) | 0V–$V_{CC}$ |
| Output Voltage ($V_{OUT}$) | 0V–$V_{CC}$ |
| Operating Temperature ($T_A$) | −40°C to +85°C |
| Input Rise and Fall Time ($t_r$, $t_f$) | |
| $V_{CC}$ @ 2.0V | 0–1000 ns |
| $V_{CC}$ @ 3.0V | 0–750 ns |
| $V_{CC}$ @ 4.5V | 0–500 ns |
| $V_{CC}$ @ 6.0V | 0–400 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

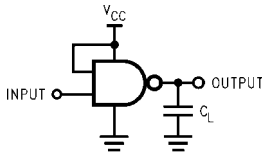
| Symbol | Parameter | $V_{CC}$ | $T_A = +25°C$ | | | $T_A = -40°C$ to $+85°C$ | | Units | Conditions |
|---|---|---|---|---|---|---|---|---|---|
| | | (V) | Min | Typ | Max | Min | Max | | |
| $V_{IH}$ | HIGH Level Input Voltage | 2.0 | 1.50 | | | 1.50 | | V | |
| | | 3.0 - 6.0 | 0.7 $V_{CC}$ | | | 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<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 | | | |
| | | | | | | | | 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<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 | | |
| | | | | | | | | 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 | Figure Number |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | | | |
| $t_{PLH}$, $t_{PHL}$ | Propagation Delay | 5.0 | | 3.5 | 15 | | | ns | $C_L = 15$ pF | Figures 1, 3 |
| | | 2.0 | | 19 | 100 | | 125 | ns | $C_L = 50$ pF | |
| | | 3.0 | | 10.5 | 27 | | 35 | | | |
| | | 4.5 | | 7.5 | 20 | | 25 | | | |
| | | 6.0 | | 6.5 | 17 | | 21 | | | |
| $t_{TLH}$, $t_{THL}$ | Output Transition Time | 5.0 | | 3.0 | 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: $I_{CCD} = (C_{PD})(V_{CC})(f_{IN}) + (I_{CC}\text{static})$.

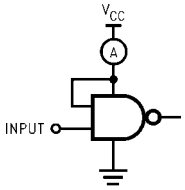
## AC Loading and Waveforms




$C_L$ includes load and stray capacitance

Input PRR = 1.0 MHz, $t_w$ = 500 ns

**FIGURE 1. AC Test Circuit**




Input = AC Waveform;

PRR = variable; Duty Cycle = 50%

**FIGURE 2. $I_{CCD}$ Test Circuit**

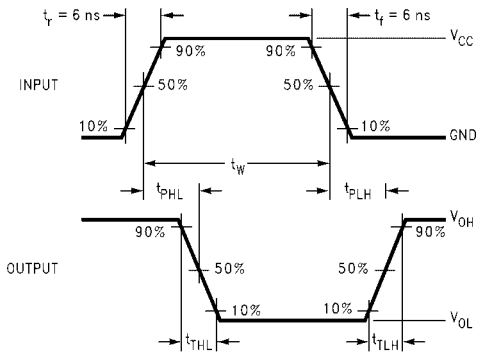


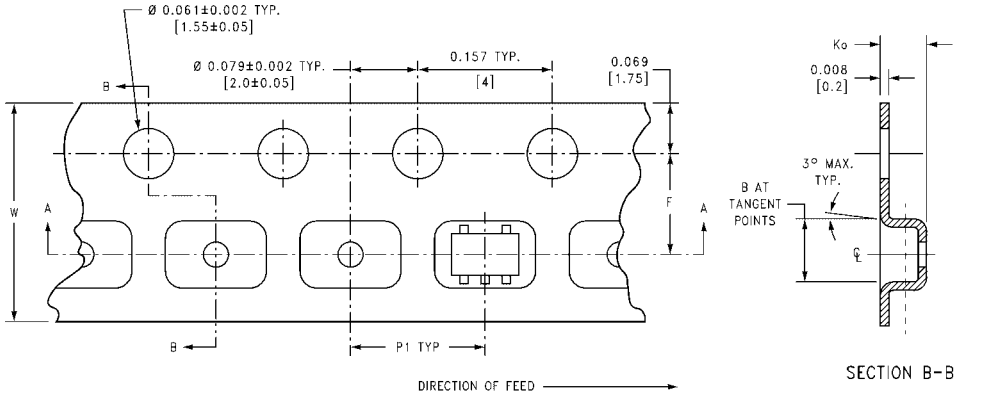

**FIGURE 3. AC Waveforms**

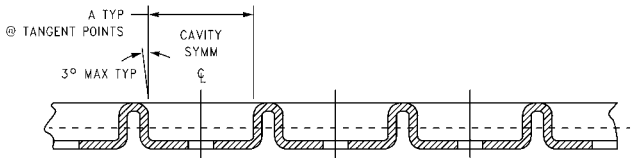
# Tape and Reel Specification

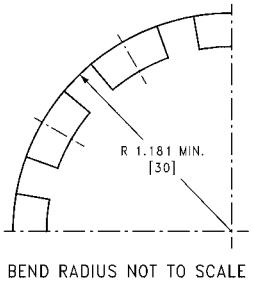
**TAPE FORMAT for SC70 and SOT23**

| 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)



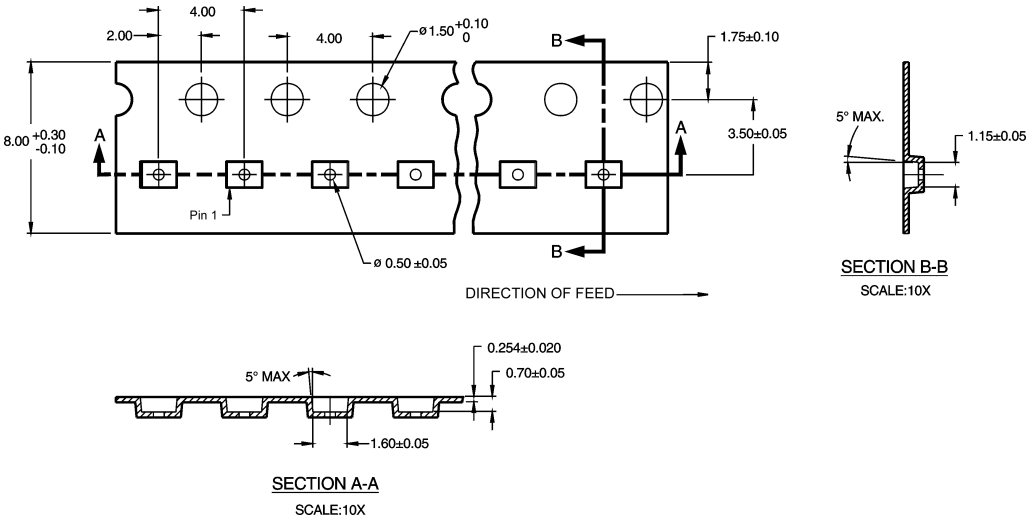




| Package | Tape Size | DIM A | DIM B | DIM F | DIM $K_o$ | DIM P1 | DIM W |
|---|---|---|---|---|---|---|---|
| SC70-5 | 8 mm | 0.093 (2.35) | 0.096 (2.45) | 0.138 ±0.004 (3.5 ±0.10) | 0.053 ±0.004 (1.35 ±0.10) | 0.157 (4) | 0.315 ±0.004 (8 ±0.1) |
| SOT23-5 | 8 mm | 0.130 (3.3) | 0.130 (3.3) | 0.138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

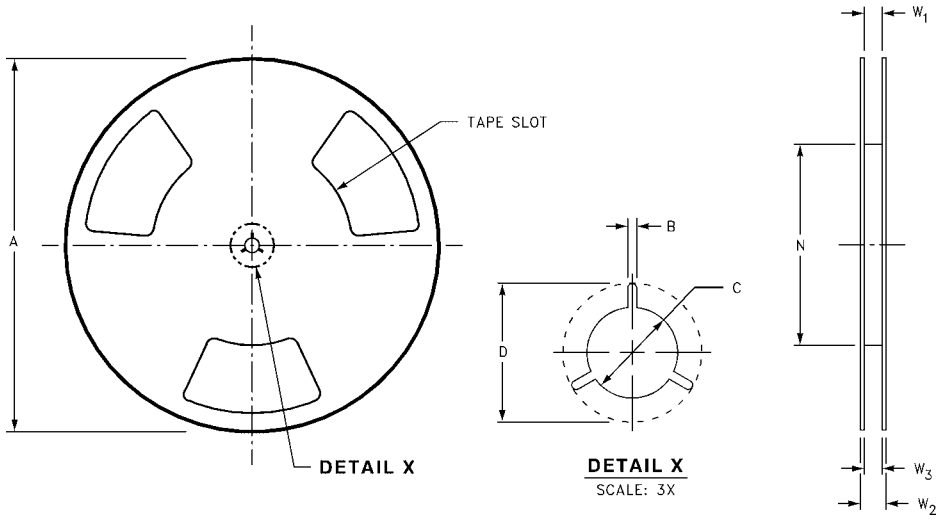
## Tape and Reel Specification (Continued)

**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 |

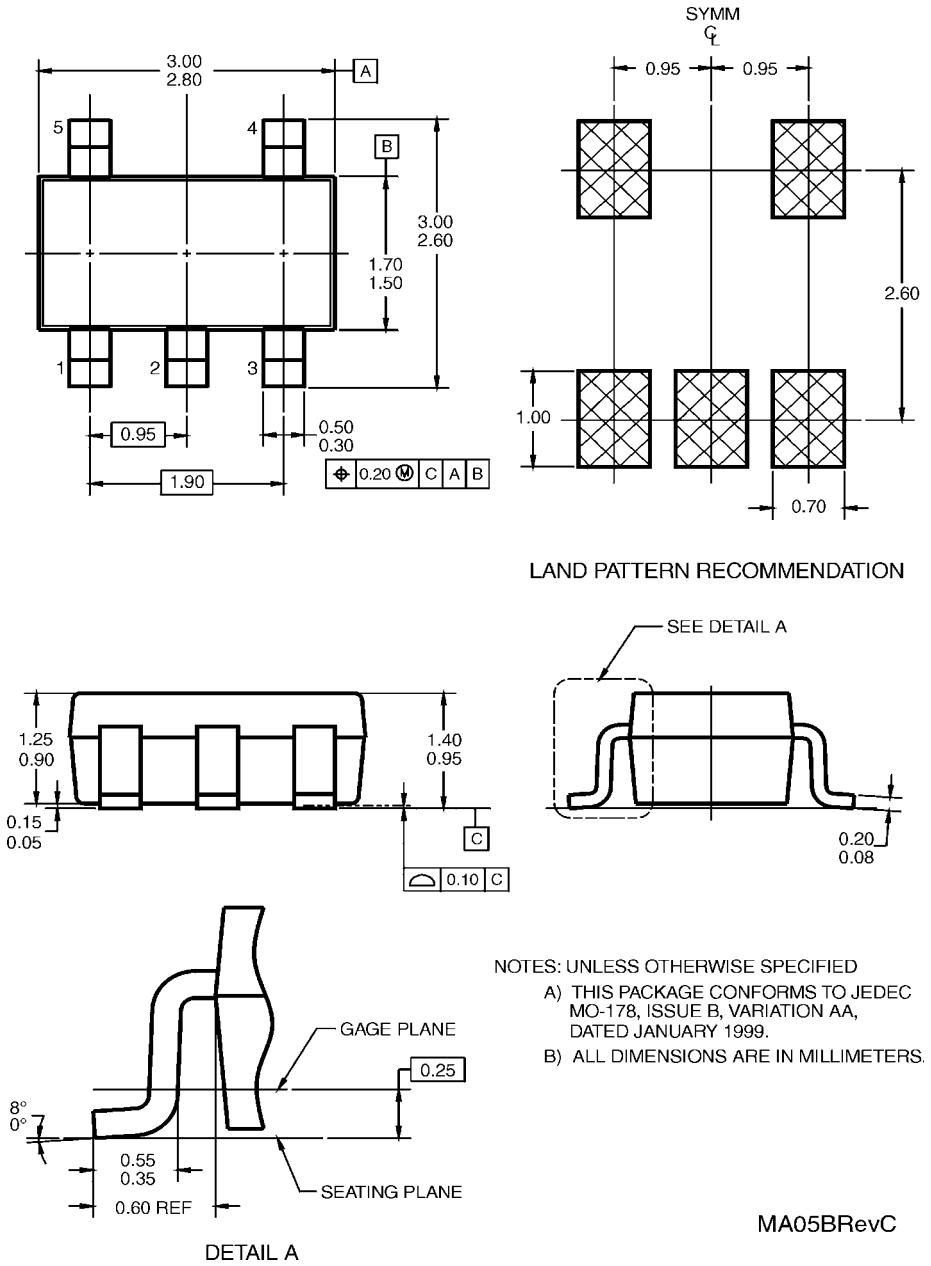



**REEL DIMENSIONS** inches (millimeters)



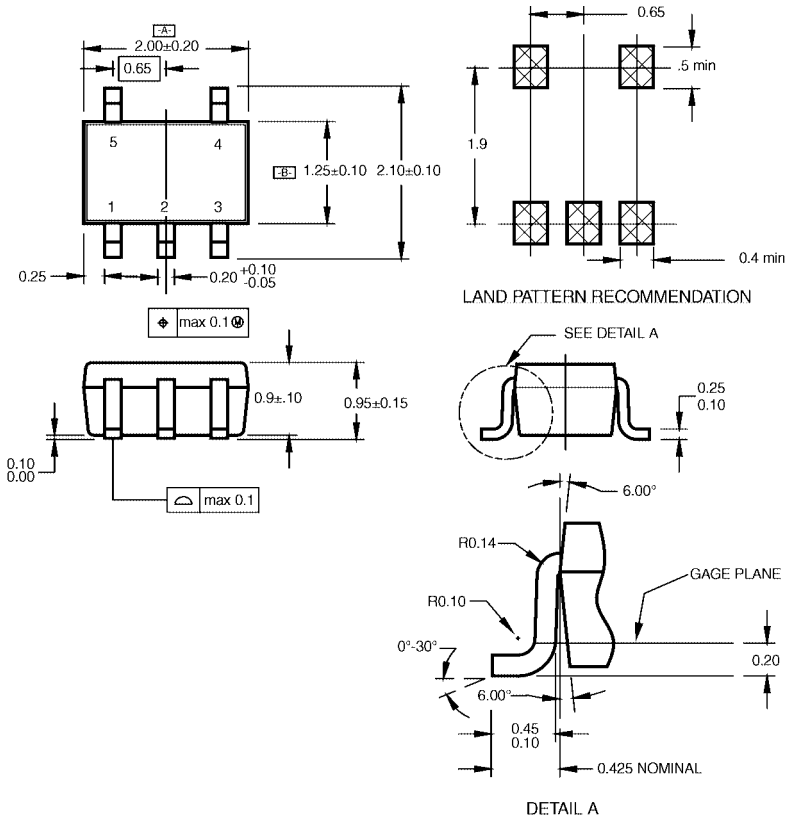

| Tape Size | A | B | C | D | N | W1 | W2 | W3 |
|---|---|---|---|---|---|---|---|---|
| 8 mm | 7.0 (177.8) | 0.059 (1.50) | 0.512 (13.00) | 0.795 (20.20) | 2.165 (55.00) | 0.331 +0.059/–0.000 (8.40 +1.50/–0.00) | 0.567 (14.40) | W1 +0.078/–0.039 (W1 +2.00/–1.00) |

## 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)



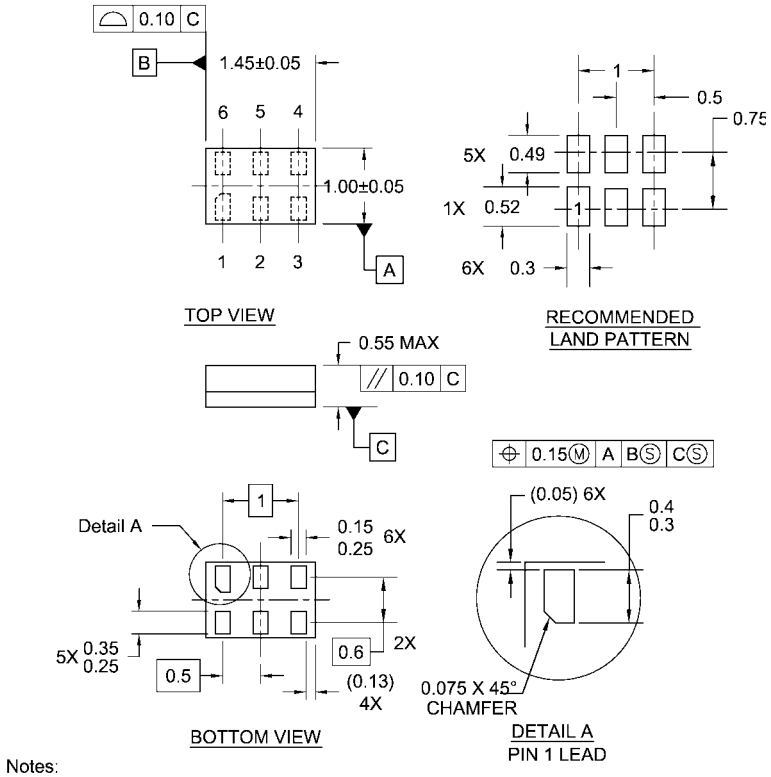

NOTES:

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**

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