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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.

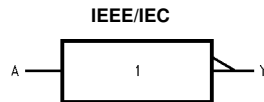
### Features

- Space saving SOT23 or SC70 5-lead package
- Ultra small MicroPak™ leadless package
- High Speed:  $t_{PD} = 3$  ns typ
- Low Quiescent Power:  $I_{CC} < 1 \mu A$
- 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:

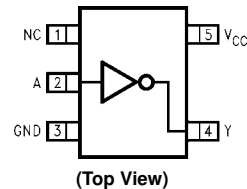
Order Number	Package Number	Product Code Top Mark	Package Description	Supplied As
NC7S04M5X	MA05B	7S04	5-Lead SOT23, JEDEC MO-178, 1.6mm	3k Units on Tape and Reel
NC7S04P5X	MAA05A	S04	5-Lead SC70, EIAJ SC-88a, 1.25mm Wide	3k Units on Tape and Reel
NC7S04L6X	MAC06A	AA	6-Lead MicroPak, 1.0mm Wide	5k Units on Tape and Reel

### Logic Symbol



### Connection Diagrams

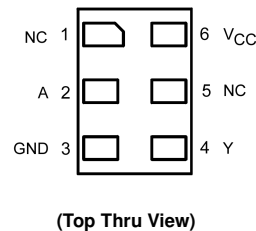
#### Pin Assignments for SC70 and SOT23



### Pin Descriptions

Pin Names	Description
A	Input
Y	Output
NC	No Connect

#### Pad Assignments for MicroPak



### Function Table

$$Y = \bar{A}$$

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 ( $I_{IK}$ )	
@ $V_{IN} \leq -0.5V$	-20 mA
@ $V_{IN} \geq V_{CC} + 0.5V$	+20 mA
DC Input Voltage ( $V_{IN}$ )	-0.5V to $V_{CC} + 0.5V$
DC Output Diode Current ( $I_{OK}$ )	
@ $V_{OUT} \leq -0.5V$	-20 mA
@ $V_{OUT} \geq V_{CC} + 0.5V$	+20 mA
DC Output Voltage ( $V_{OUT}$ )	-0.5V to $V_{CC} + 0.5V$
DC Output Source or Sink Current ( $I_{OUT}$ )	$\pm 12.5$ mA
DC $V_{CC}$ or Ground Current per Output Pin ( $I_{CC}$ or $I_{GND}$ )	$\pm 25$ 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**

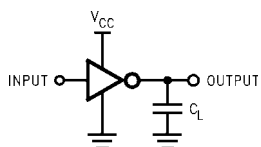
Symbol	Parameter	$V_{CC}$ (V)	$T_A = +25^\circ\text{C}$			$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		Units	Conditions	
			Min	Typ	Max	Min	Max			
$V_{IH}$	HIGH Level Input Voltage	2.0	1.50			1.50		V		
		3.0 - 6.0	0.7 $V_{CC}$			0.7 $V_{CC}$				
$V_{IL}$	LOW Level Input Voltage	2.0			0.50		0.50	V		
		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	$I_{OH} = -20 \mu\text{A}$ $V_{IN} = V_{IL}$	
		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	$V_{IN} = V_{IL}$ $I_{OH} = -1.3 \text{ mA}$ $I_{OH} = -2.0 \text{ mA}$ $I_{OH} = -2.6 \text{ mA}$
			4.5	4.18	4.35		4.13			
			6.0	5.68	5.85		5.63			
$V_{OL}$	LOW Level Output Voltage	2.0		0.0	0.10		0.10	V	$I_{OL} = 20 \mu\text{A}$ $V_{IN} = V_{IH}$	
		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	$V_{IN} = V_{IH}$ $I_{OL} = 1.3 \text{ mA}$ $I_{OL} = 2.0 \text{ mA}$ $I_{OL} = 2.6 \text{ mA}$
			4.5		0.1	0.26		0.33		
			6.0		0.1	0.26		0.33		
$I_{IN}$	Input Leakage Current	6.0		$\pm 0.1$		$\pm 1.0$	$\mu\text{A}$	$V_{IN} = V_{CC}, \text{ GND}$		
$I_{CC}$	Quiescent Supply Current	6.0		1.0		10.0	$\mu\text{A}$	$V_{IN} = V_{CC}, \text{ GND}$		

## AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> (V)	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40°C to +85°C		Units	Conditions	Figure Number
			Min	Typ	Max	Min	Max			
t <sub>PLH</sub>	Propagation Delay	5.0		3.0	15.0			ns	C <sub>L</sub> = 15 pF	Figures 1, 3
t <sub>PHL</sub>		2.0	18.0	100.0		125.0		ns	C <sub>L</sub> = 50 pF	
		3.0	10.0	27.0		35.0				
		4.5	7.0	20.0		25.0				
		6.0	6.0	17.0		21.0				
t <sub>TLH</sub>	Output Transition Time	5.0	3.0	10.0				ns	C <sub>L</sub> = 15 pF	Figures 1, 3
t <sub>THL</sub>		2.0	25.0	125.0		155.0		ns	C <sub>L</sub> = 50 pF	
		3.0	16.0	35.0		45.0				
		4.5	11.0	25.0		31.0				
		6.0	9.0	21.0		26.0				
C <sub>IN</sub>	Input Capacitance	Open	2.0	10.0		10.0		pF		
C <sub>PD</sub>	Power Dissipation Capacitance	5.0	6.0					pF	(Note 3)	Figure 2

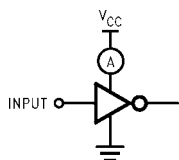
**Note 3:** C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I<sub>CCD</sub>) at no output loading and operating at 50% duty cycle. (See Figure 2.) C<sub>PD</sub> is related to I<sub>CCD</sub> dynamic operating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

## AC Loading and Waveforms



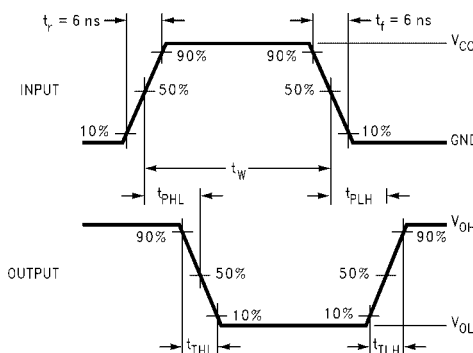
C<sub>L</sub> includes load and stray capacitance  
 Input PRR = 1.0 MHz, t<sub>w</sub> = 500 ns

**FIGURE 1. AC Test Circuit**



Input = AC Waveforms;  
 PRR = Variable; Duty Cycle = 50%

**FIGURE 2. I<sub>CCD</sub> Test Circuit**



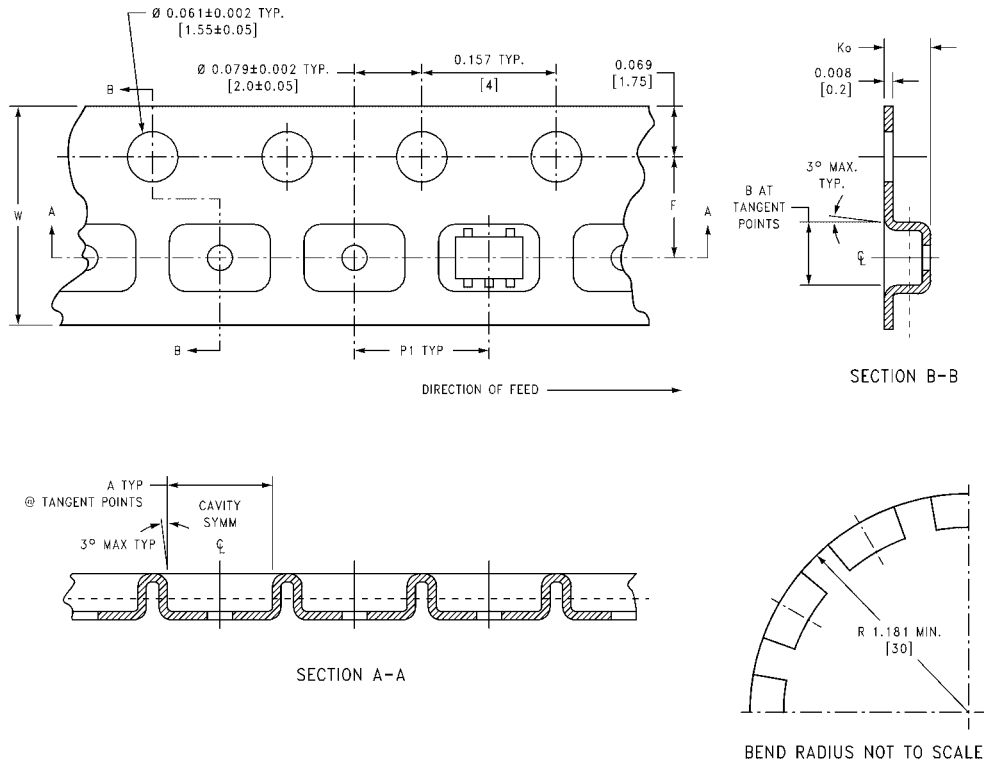
**FIGURE 3. AC Waveforms**

### Tape and Reel Specification

**TAPE FORMAT FOR SOT23, 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)



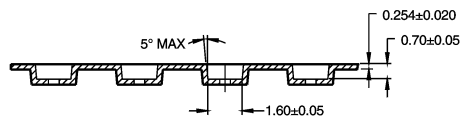
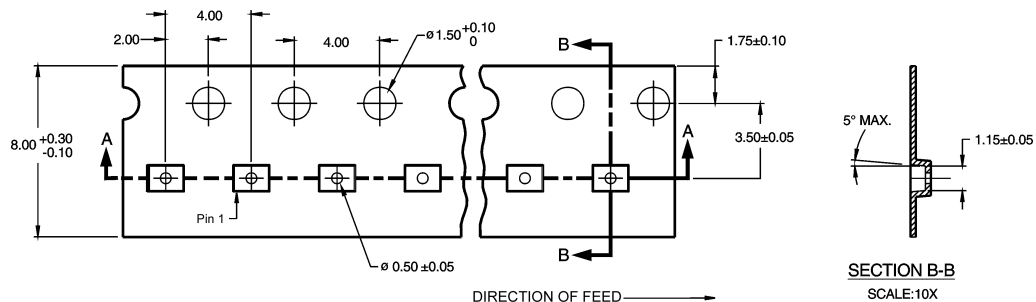
Package	Tape Size	DIM A	DIM B	DIM F	DIM K <sub>0</sub>	DIM P1	DIM W
SC70-5	8 mm	0.093 (2.35)	0.096 (2.45)	0.138 ± 0.004 (3.5 ± 0.10)	0.053 ± 0.004 (1.35 ± 0.10)	0.157 (4)	0.315 ± 0.004 (8 ± 0.1)
SOT23-5	8 mm	0.130 (3.3)	0.130 (3.3)	0.138 ± 0.002 (3.5 ± 0.05)	0.055 ± 0.004 (1.4 ± 0.11)	0.157 (4)	0.315 ± 0.012 (8 ± 0.3)

### Tape and Reel Specification (Continued)

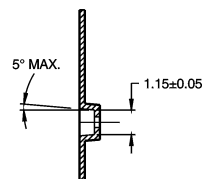
#### TAPE FORMAT FOR MicroPak

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

#### TAPE DIMENSIONS inches (millimeters)

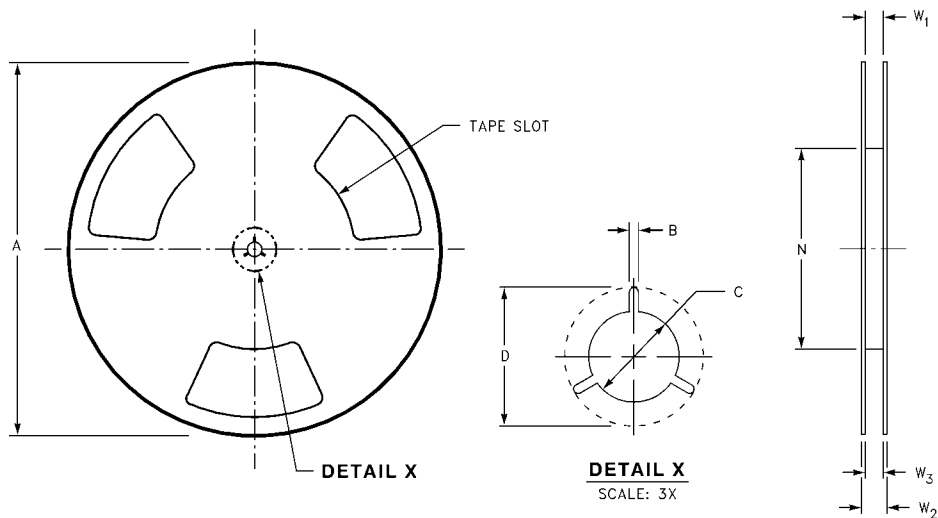


**SECTION A-A**  
SCALE: 10X



**SECTION B-B**  
SCALE: 10X

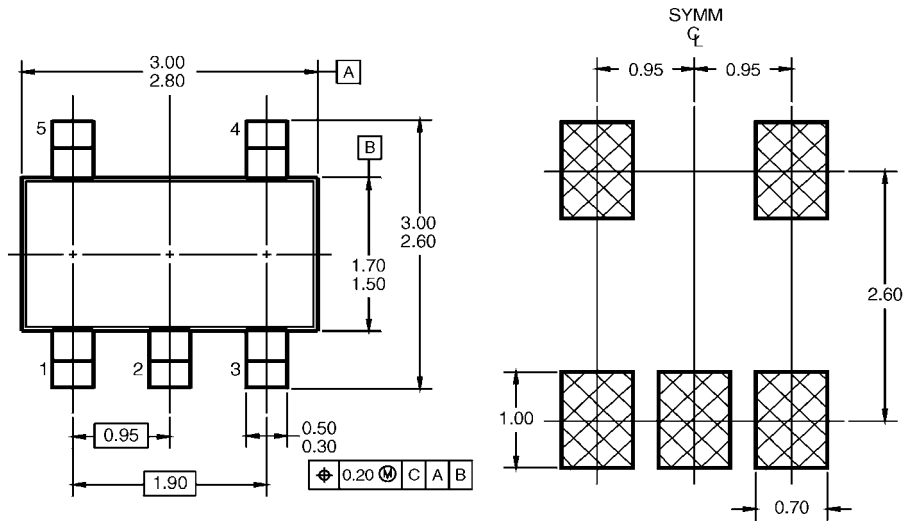
#### REEL DIMENSIONS inches (millimeters)



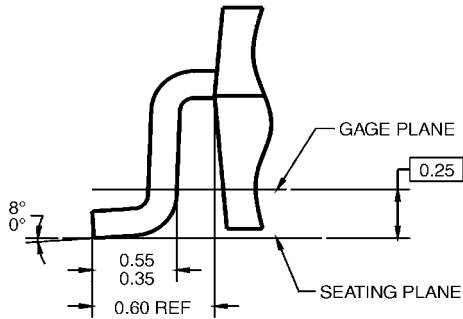
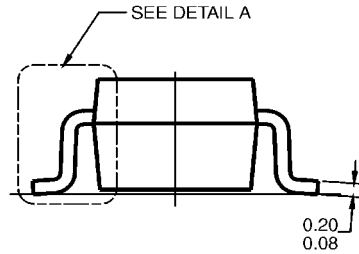
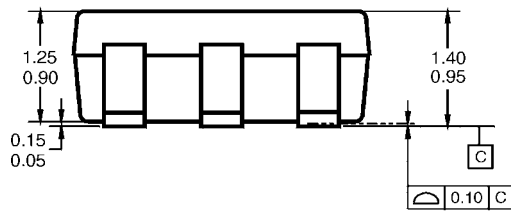
**DETAIL X**  
SCALE: 3X

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



LAND PATTERN RECOMMENDATION



DETAIL A

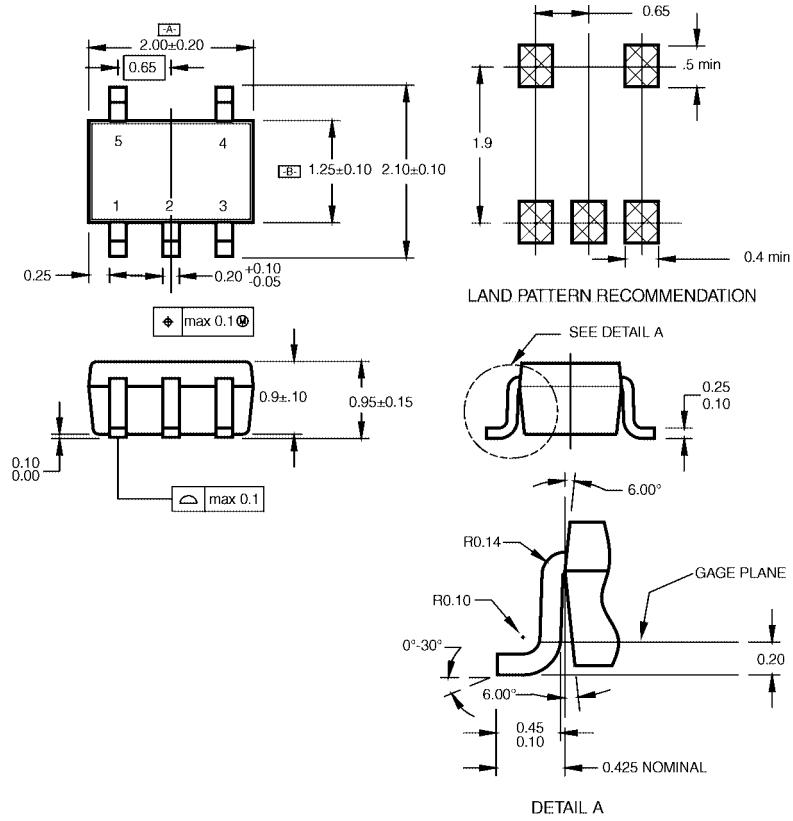
- NOTES: UNLESS OTHERWISE SPECIFIED
- A) THIS PACKAGE CONFORMS TO JEDEC MO-178, ISSUE B, VARIATION AA, DATED JANUARY 1999.
  - B) ALL DIMENSIONS ARE IN MILLIMETERS.

MA05BRevC

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



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



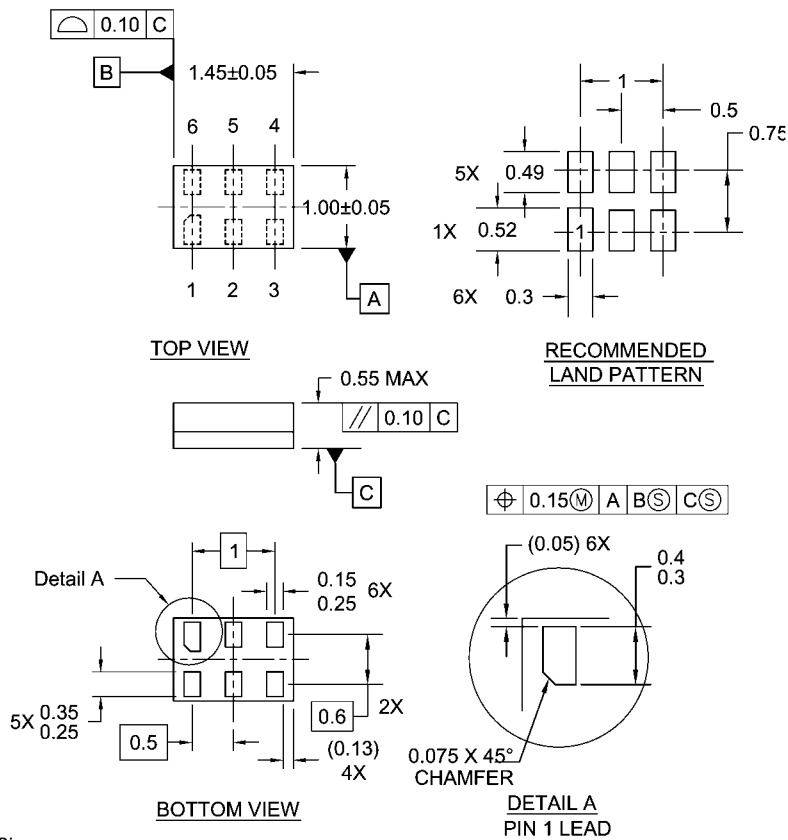
NOTES:

- 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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