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NC7SU04 TinyLogic® HS Unbuffered Inverter

General Description

The NC7SU04 is a single special purpose CMOS Inverter. The inverter circuit is designed with a single unbuffered stage to facilitate use in crystal oscillator applications. It is not intended for use in logic inversion applications.

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.

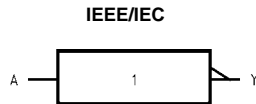
Features

- Space saving SOT23 or SC70 5-lead package
- Ultra small MicroPak™ leadless package
- Unbuffered for crystal oscillator applications
- 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 |
|--------------|----------------|-----------------------|---------------------------------------|---------------------------|
| NC7SU04M5X | MA05B | 7SU4 | 5-Lead SOT23, JEDEC MO-178, 1.6mm | 3k Units on Tape and Reel |
| NC7SU04P5X | MAA05A | SU4 | 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3k Units on Tape and Reel |
| NC7SU04L6X | MAC06A | E5 | 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

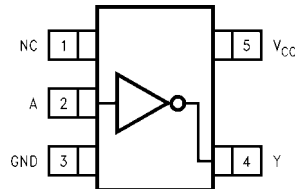
$Y = \bar{A}$

| Input | Output |
|-------|--------|
| A | Y |
| L | H |
| H | L |

H = HIGH Logic Level
L = LOW Logic Level

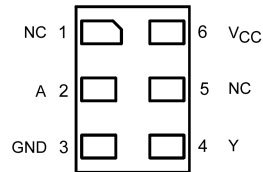
Connection Diagrams

Pin Assignments for SOT23 and SC70



(Top View)

Pad Assignments for MicroPak



(Top Thru View)

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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}) | |
| @ $V_{OUT} < -0.5V$ | -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 |

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 |
| 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 databook specifications.

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

DC Electrical Characteristics

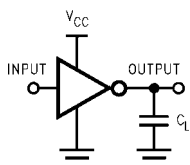
| Symbol | Parameter | V_{CC} (V) | $T_A = +25^\circ\text{C}$ | | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | Units | Conditions | |
|----------|---------------------------|-----------------|---------------------------|------|-----------|---|-----------|---------------|---|---|
| | | | Min | Typ | Max | Min | Max | | | |
| V_{IH} | HIGH Level Input Voltage | 2.0 | 1.70 | | | 1.70 | | V | | |
| | | 3.0 | 2.45 | | | 2.45 | | | | |
| | | 4.5 | 3.60 | | | 3.60 | | | | |
| | | 6.0 | 4.80 | | | 4.80 | | | | |
| V_{IL} | LOW Level Input Voltage | 2.0 | | | 0.30 | | 0.30 | V | | |
| | | 3.0 | | | 0.50 | | 0.50 | | | |
| | | 4.5 | | | 0.90 | | 0.90 | | | |
| | | 6.0 | | | 1.20 | | 1.20 | | | |
| V_{OH} | HIGH Level Output Voltage | 2.0 | 1.80 | 2.0 | | 1.80 | | V | $I_{OH} = -20 \mu\text{A}$ $V_{IN} = V_{IL}$ | |
| | | 3.0 | 2.5 | 3.0 | | 2.50 | | | | |
| | | 4.5 | 4.00 | 4.5 | | 4.00 | | | | |
| | | 6.0 | 5.50 | 5.9 | | 5.50 | | | | |
| | | | 3.0 | 2.68 | 2.82 | | 2.63 | | V | $V_{IN} = \text{GND}$ $I_{OH} = -1.3 \text{ mA}$ $I_{OH} = -2 \text{ mA}$ $I_{OH} = -2.6 \text{ mA}$ |
| | | | 4.5 | 4.18 | 4.33 | | 4.13 | | | |
| | | | 6.0 | 5.68 | 5.76 | | 5.63 | | | |
| | | | | | | | | | | |
| V_{OL} | LOW Level Output Voltage | 2.0 | | 0.00 | 0.20 | | 0.20 | V | $I_{OL} = 20 \mu\text{A}$ $V_{IN} = V_{IH}$ | |
| | | 3.0 | | 0.00 | 0.50 | | 0.50 | | | |
| | | 4.5 | | 0.01 | 0.50 | | 0.50 | | | |
| | | 6.0 | | 0.04 | 0.50 | | 0.50 | | | |
| | | | 3.0 | | 0.11 | 0.26 | | 0.33 | V | $V_{IN} = V_{CC}$ $I_{OL} = 1.3 \text{ mA}$ $I_{OL} = 2 \text{ mA}$ $I_{OL} = 2.6 \text{ mA}$ |
| | | | 4.5 | | 0.12 | 0.26 | | 0.33 | | |
| | | | 6.0 | | 0.15 | 0.26 | | 0.33 | | |
| | | | | | | | | | | |
| I_{IN} | Input Leakage Current | 6.0 | | | ± 0.1 | | ± 1.0 | μA | $V_{IN} = V_{CC}, \text{ GND}$ | |
| I_{CC} | Quiescent Supply Current | 6.0 | | | 1.0 | | 10.0 | μA | $V_{IN} = V_{CC}, \text{ GND}$ | |

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 | 15 | | | ns | C _L = 15 pF | Figures 1, 3 |
| | | 2.0 | | 17 | 100 | | 125 | ns | C _L = 50 pF | |
| | | 3.0 | | 9 | 27 | | 35 | | | |
| | | 4.5 | | 7 | 20 | | 25 | | | |
| | | 6.0 | | 6.5 | 17 | | 21 | | | |
| t _{TLH} , t _{THL} | Output Transition Time | 5.0 | | 4 | 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 | | 12 | 25 | | 31 | | | |
| | | 6.0 | | 10 | 21 | | 26 | | | |
| C _{IN} | Input Capacitance | Open | | 2 | 10 | | 10 | pF | | |
| C _{PD} | Power Dissipation Capacitance | 5.0 | | 4 | | | | pF | (Note 3) | Figure 2 |

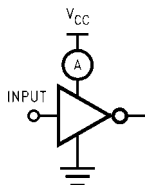
Note 3: C_{PD} is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I_{CCD}) at no output loading and operating at 50% duty cycle. (See Figure 2.) C_{PD} is related to I_{CCD} dynamic operating current by the expression:
 $I_{CCD}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

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

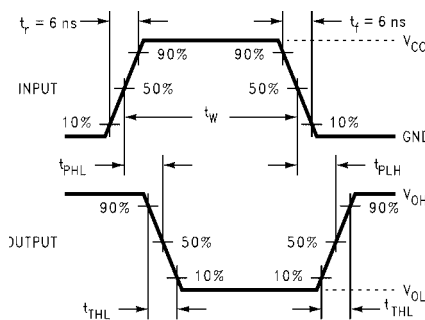


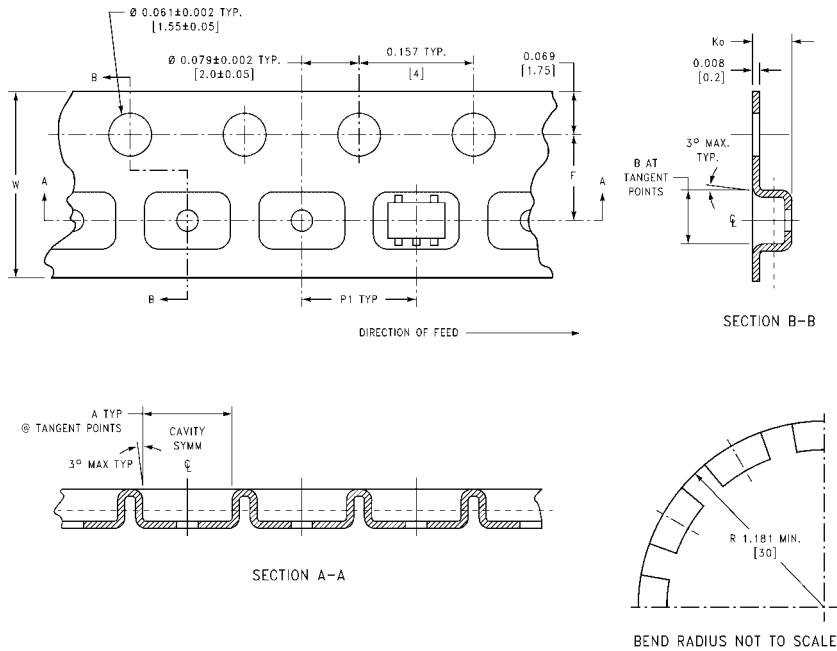
FIGURE 3. AC Waveforms

Tape and Reel Specification

TAPE FORMAT for 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 |

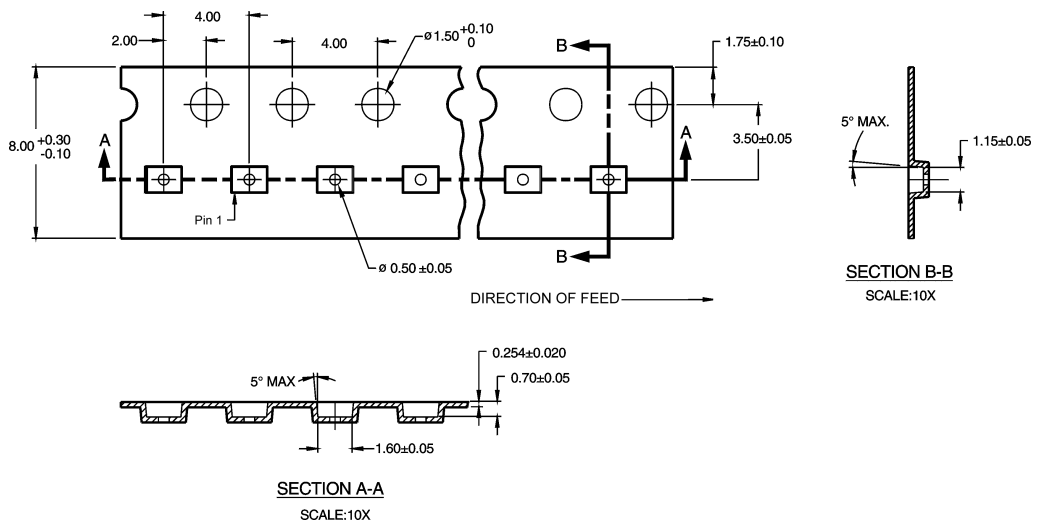
TAPE DIMENSIONS inches (millimeters)



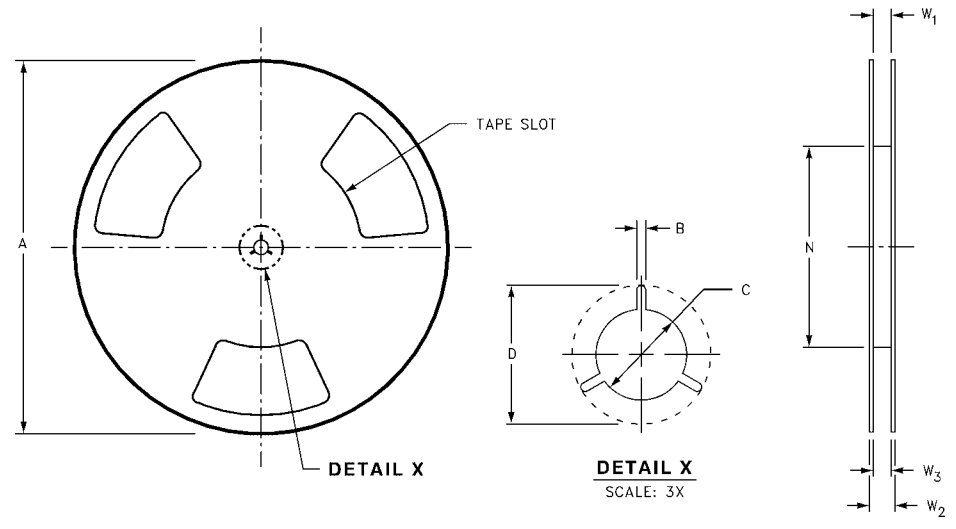
| Package | Tape Size | DIM A | DIM B | DIM F | DIM K ₀ | DIM P1 | DIM W |
|---------|-----------|-----------------|-----------------|-------------------------------|--------------------------------|--------------|----------------------------|
| SC70-5 | 8 mm | 0.093 (2.35) | 0.096 (2.45) | 0.138 ± 0.004 (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 |

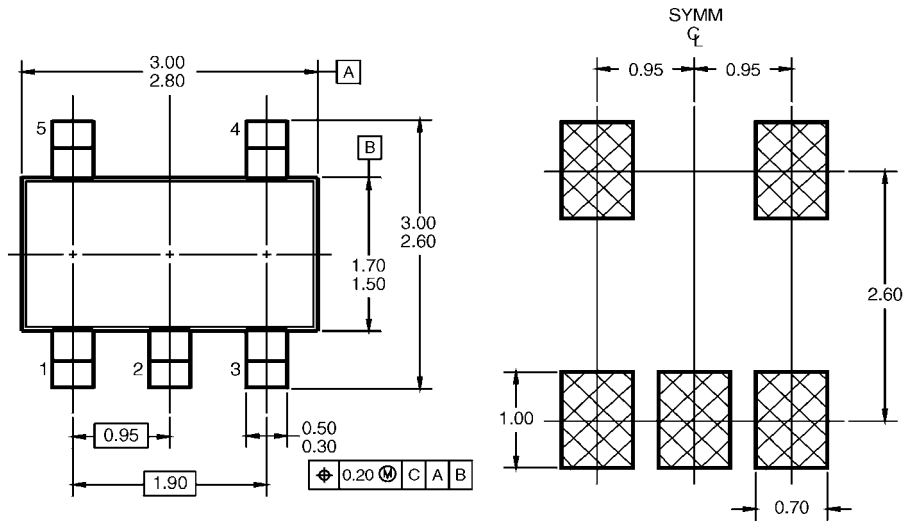


REEL DIMENSIONS inches (millimeters)

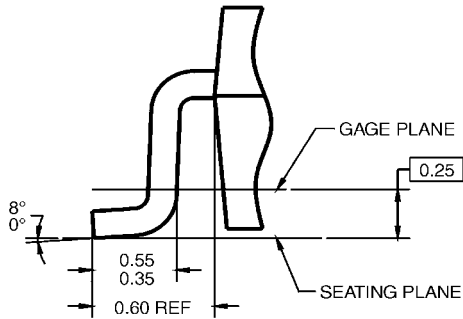
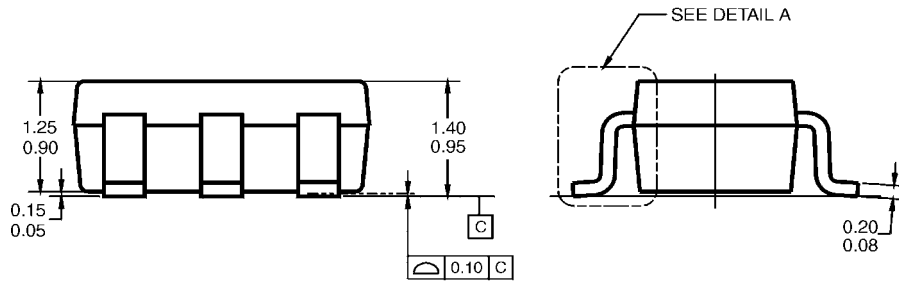


| Tape Size | A | B | C | D | N | W1 | W2 | W3 |
|-----------|----------------|-----------------|------------------|------------------|------------------|---|------------------|--|
| 8 mm | 7.0 (177.8) | 0.059 (1.50) | 0.512 (13.00) | 0.795 (20.20) | 2.165 (55.00) | 0.331 + 0.059/-0.000 (8.40 + 1.50/-0.00)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

Physical Dimensions inches (millimeters) unless otherwise noted



LAND PATTERN RECOMMENDATION

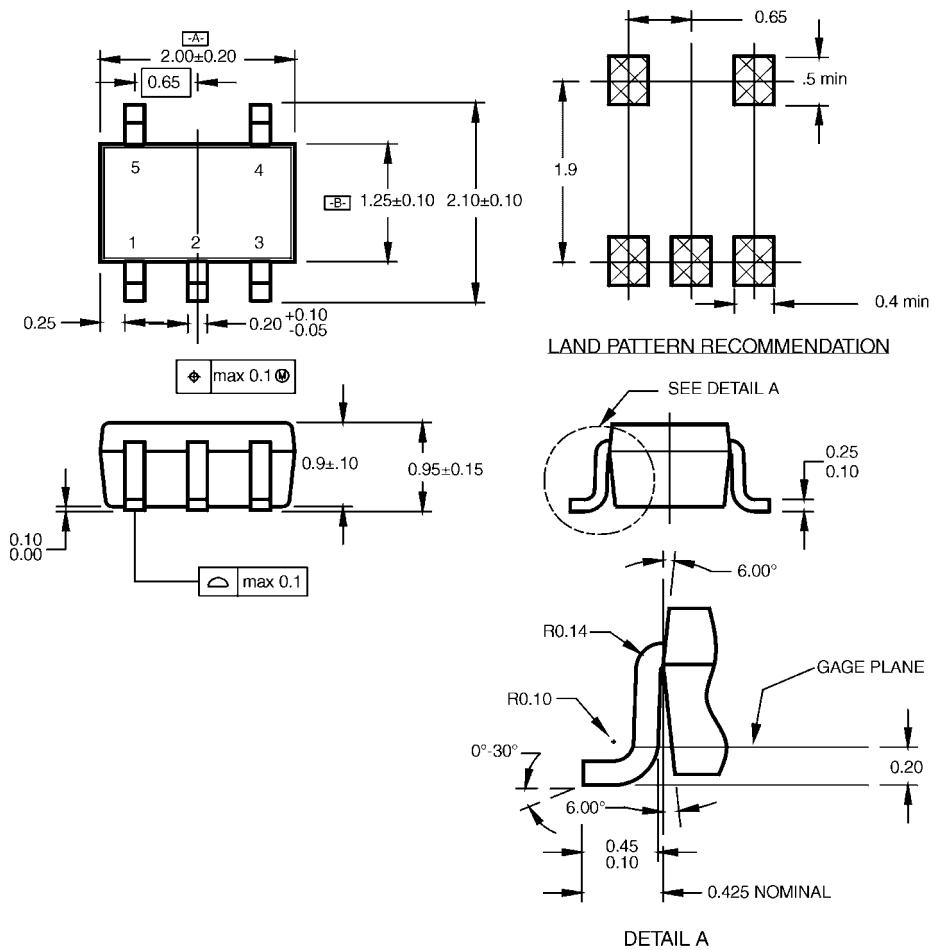


- NOTES: UNLESS OTHERWISE SPECIFIED
- A) THIS PACKAGE CONFORMS TO JEDEC MO-178, ISSUE B, VARIATION AA, DATED JANUARY 1999.
 - B) ALL DIMENSIONS ARE IN MILLIMETERS.

MA05BRevC

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

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



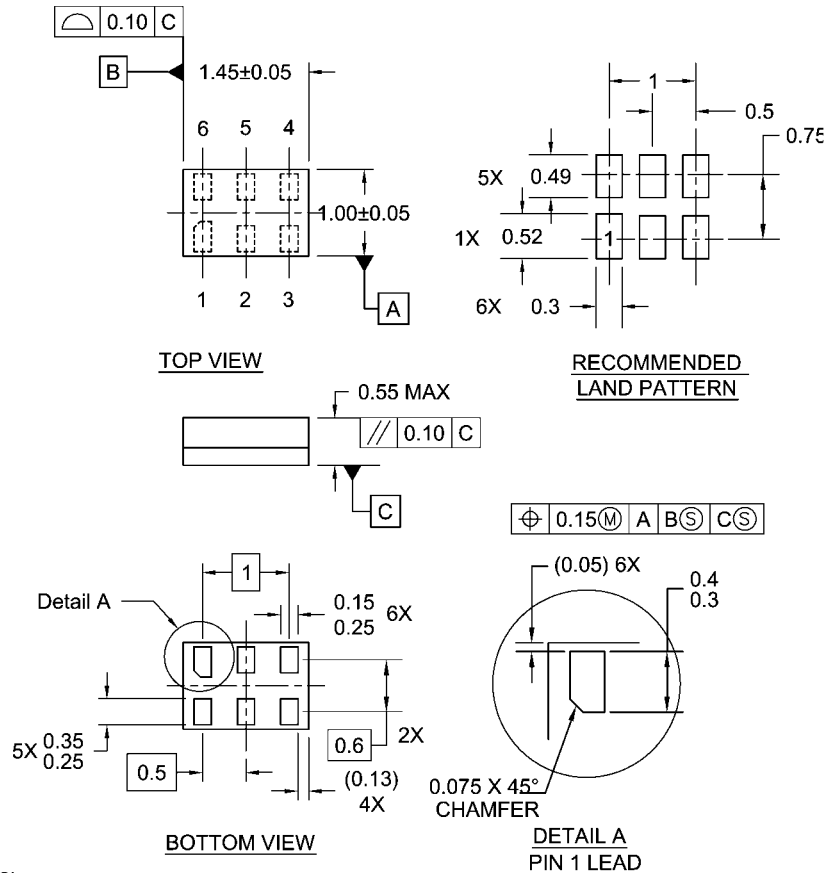
NOTES:

- 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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