October 1995
Revised August 2004

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; $I_{CC} < 1$ 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
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

IEEE/IEC

Pin Descriptions

Pin Names	Description
A	Input
Y	Output
NC	No Connect

Function Table

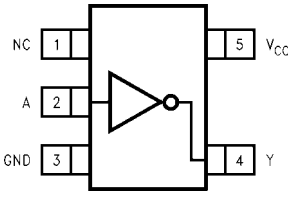
$Y = \overline{A}$

Input	Output
A	**Y**
L	H
H	L

H = HIGH Logic Level
L = LOW Logic Level

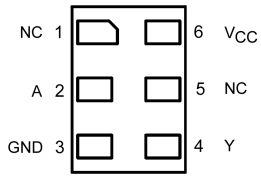
Connection Diagrams

Pin Assignments for SOT23 and SC70



(Top View)

Pad Assignments for MicroPak



(Top Thru View)

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

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

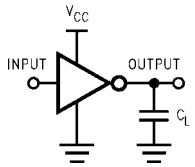
Symbol	Parameter	V_{CC}	T_A = +25°C			T_A = −40°C to +85°C		Units	Conditions
		(V)	Min	Typ	Max	Min	Max		
V_{IH}	HIGH Level Input Voltage	2.0	1.70			1.70		V	
		3.0	2.45			2.45			
		4.5	3.60			3.60			
		6.0	4.80			4.80			
V_{IL}	LOW Level Input Voltage	2.0			0.30		0.30	V	
		3.0			0.50		0.50		
		4.5			0.90		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 μA 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} = GND I_{OH} = −1.3 mA
		4.5	4.18	4.33		4.13			I_{OH} = −2 mA
		6.0	5.68	5.76		5.63			I_{OH} = −2.6 mA
V_{OL}	LOW Level Output Voltage	2.0		0.00	0.20		0.20	V	I_{OL} = 20 μA 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 mA
		4.5		0.12	0.26		0.33		I_{OL} = 2 mA
		6.0		0.15	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	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: $I_{CCD} = (C_{PD})(V_{CC})(f_{IN}) + (I_{CC}\text{static})$.

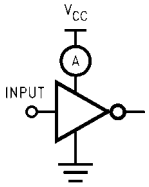
AC Loading and Waveforms



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

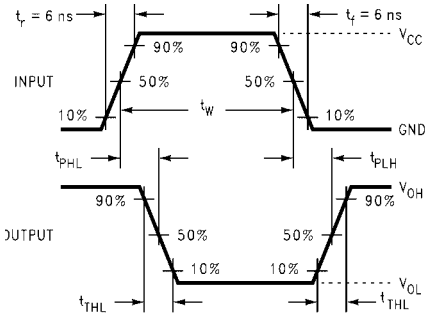


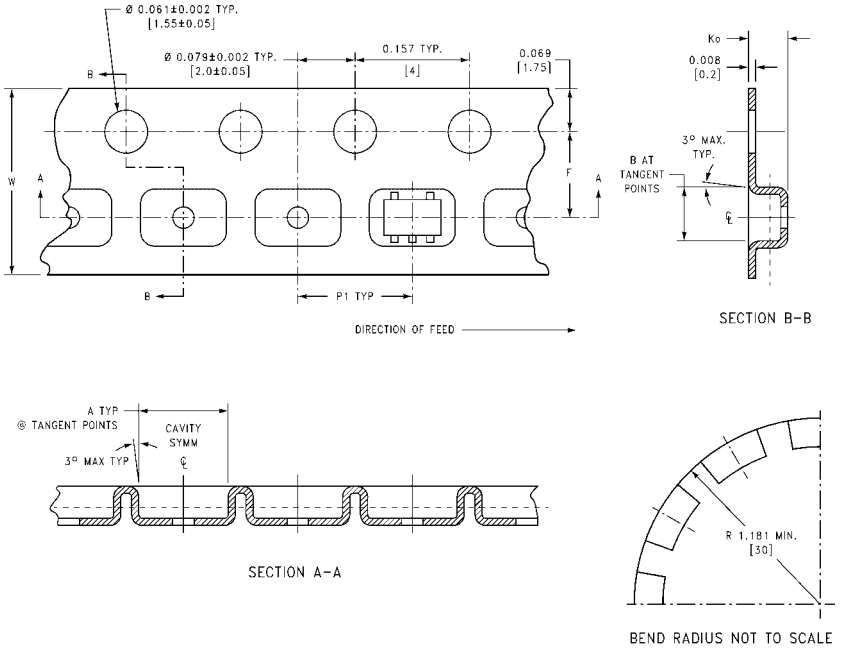
FIGURE 3. AC Waveforms

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)

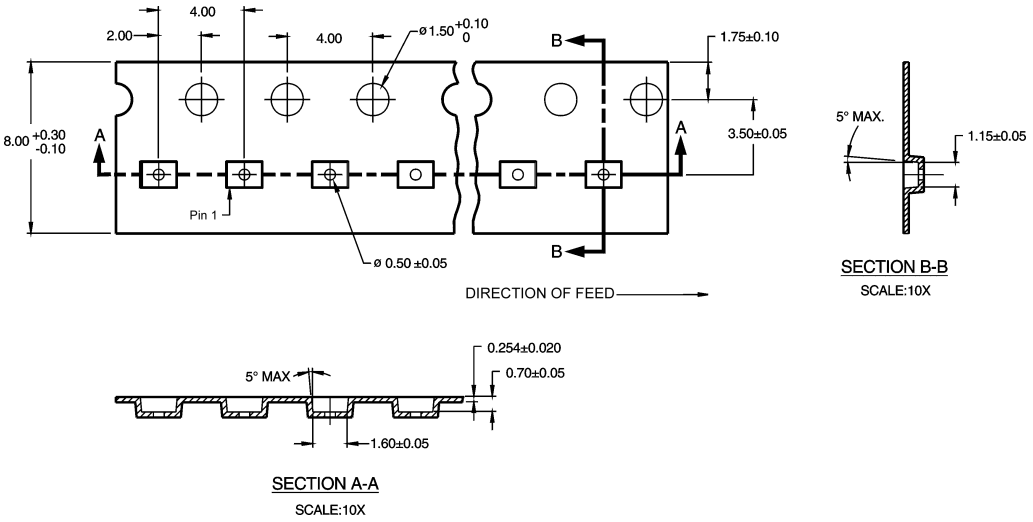


Package	Tape Size	DIM A	DIM B	DIM F	DIM K_o	DIM P1	DIM W
SC70-5	8 mm	0.093 (2.35)	0.096 (2.45)	0.138 ± 0.004 (3.5 ± 0.10)	0.053 ± 0.004 (1.35 ± 0.10)	0.157 (4)	0.315 ± 0.004 (8 ± 0.1)
SOT23-5	8 mm	0.130 (3.3)	0.130 (3.3)	0.138 ± 0.002 (3.5 ± 0.05)	0.055 ± 0.004 (1.4 ± 0.11)	0.157 (4)	0.315 ± 0.012 (8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

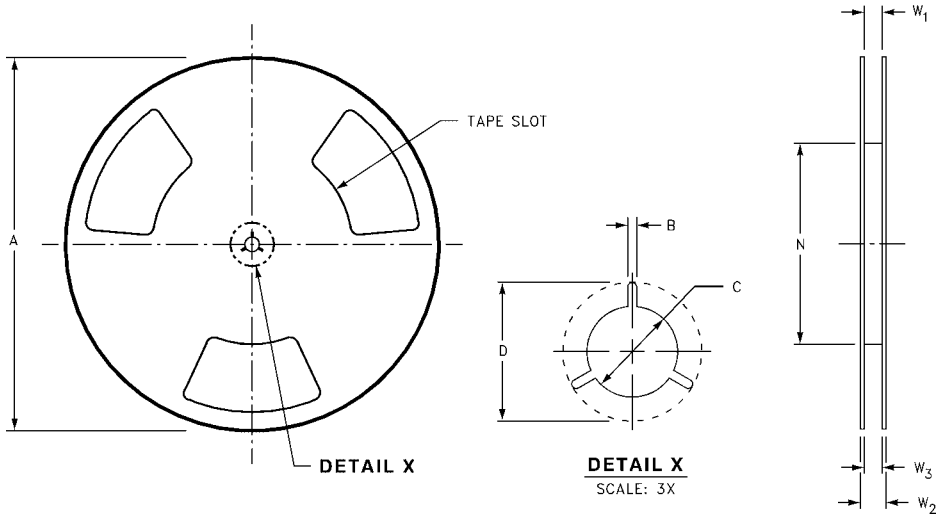
Tape and Reel Specification (Continued)

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

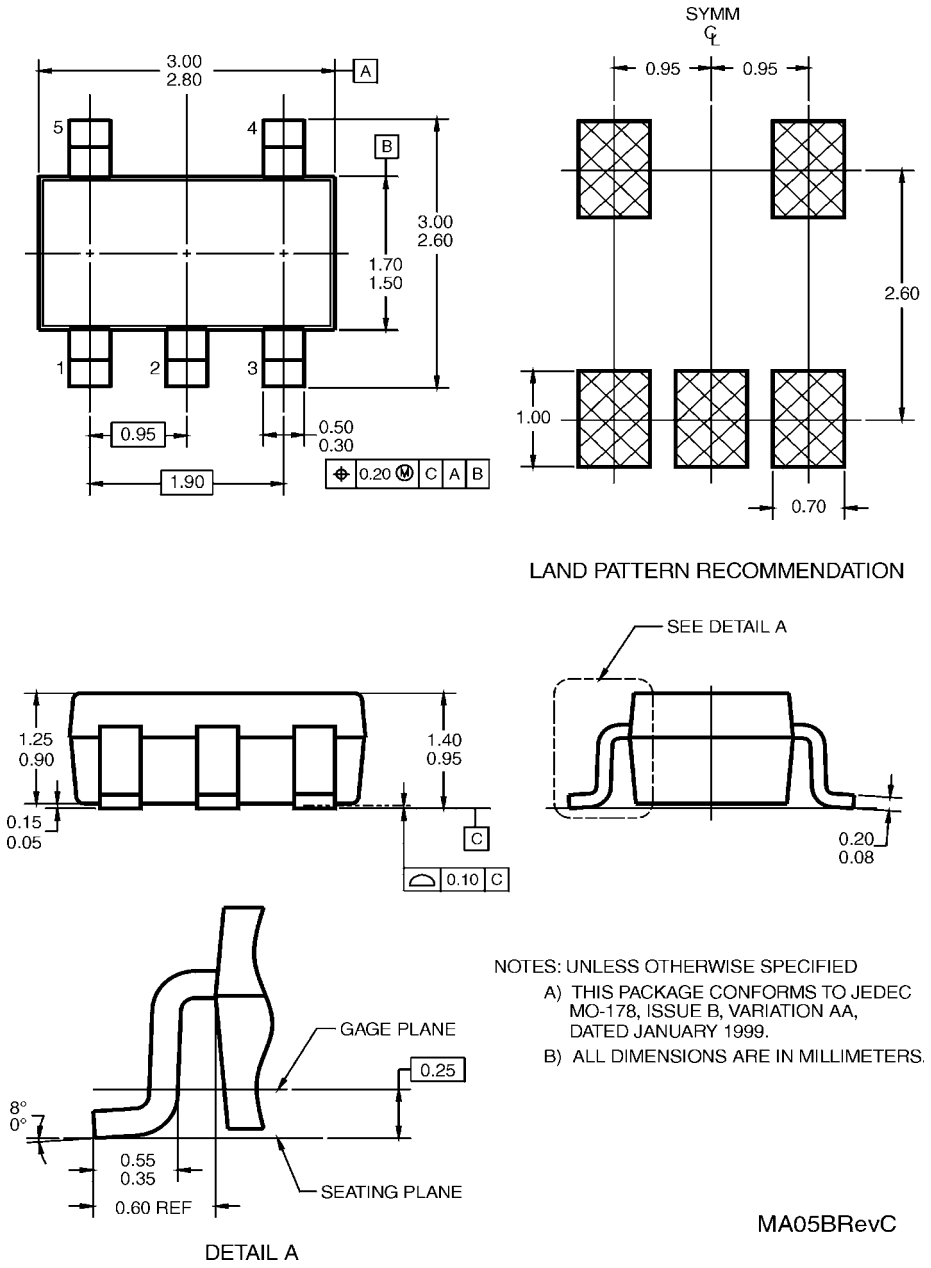


REEL DIMENSIONS inches (millimeters)



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



NOTES: UNLESS OTHERWISE SPECIFIED

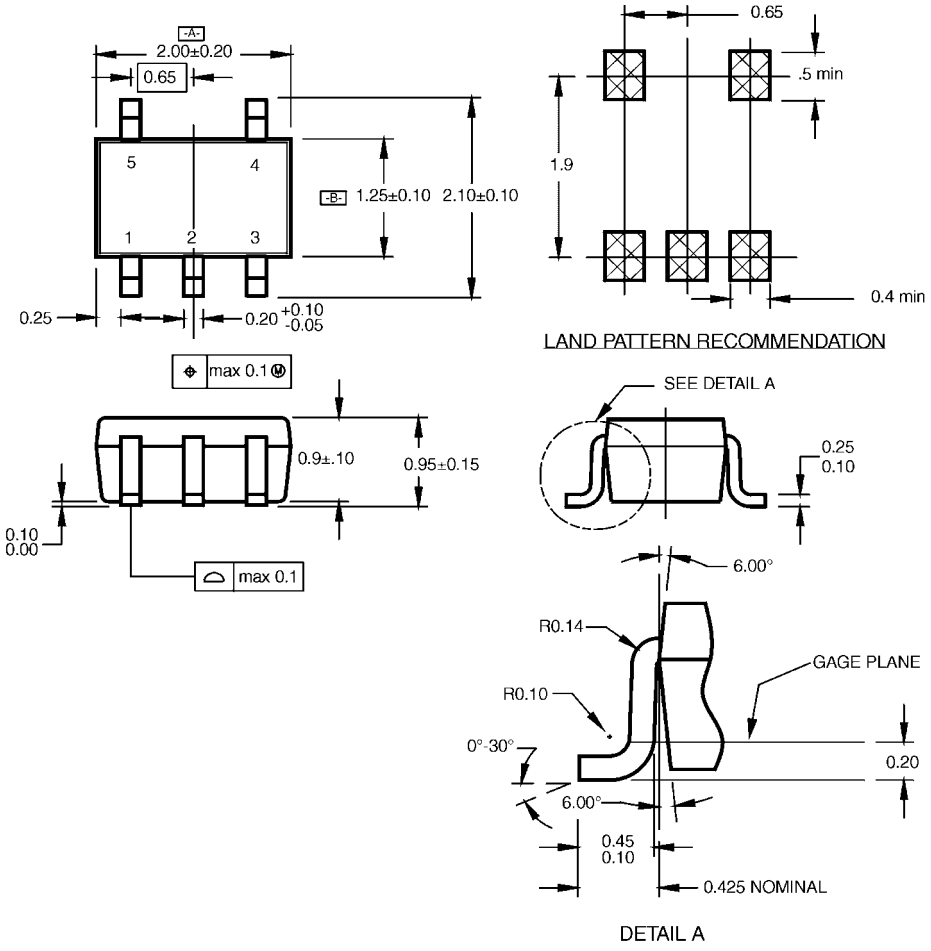
A) THIS PACKAGE CONFORMS TO JEDEC MO-178, ISSUE B, VARIATION AA, DATED JANUARY 1999.

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)



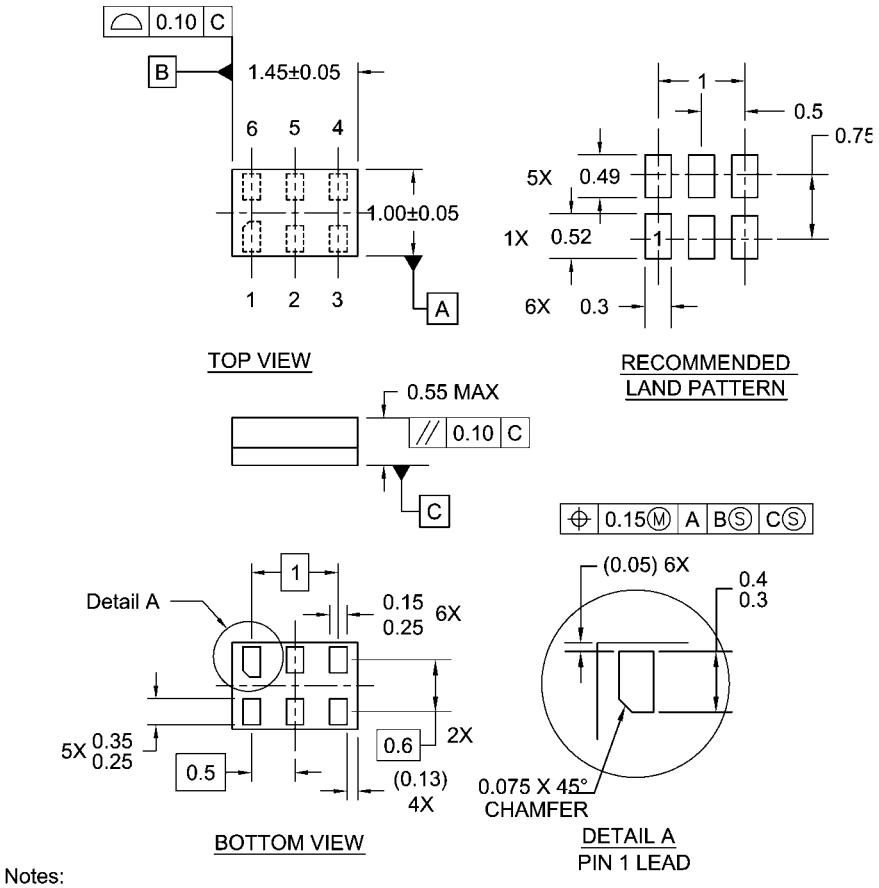
NOTES:

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