Jameco Part Number 874138

FAIRCHILD SEMICONDUCTOR®

October 1996
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# NC7SZ125
# TinyLogic® UHS Buffer with 3-STATE Output

## General Description

The NC7SZ125 is a single buffer with 3-STATE output from Fairchild's Ultra High Speed Series of TinyLogic®. The device is fabricated with advanced CMOS technology to achieve ultra high speed with high output drive while maintaining low static power dissipation over a very broad $V_{CC}$ operating range. The device is specified to operate over the 1.65V to 5.5V range.

The inputs and output are high impedance above ground when $V_{CC}$ is 0V. Inputs tolerate voltages up to 6V independent of $V_{CC}$ operating voltage. The output tolerates voltages above $V_{CC}$ when in the 3-STATE condition.

## Features

- Space saving SOT23 or SC70 5-lead package
- Ultra small MicroPak™ Pb-Free leadless package
- Ultra High Speed; $t_{PD}$ 2.6 ns Typ into 50 pF at 5V $V_{CC}$
- High Output Drive; ±24 mA at 3V $V_{CC}$
- Broad $V_{CC}$ Operating Range; 1.65V to 5.5V
- Matches the performance of LCX when operated at 3.3V $V_{CC}$
- Power down high impedance inputs/output
- Overvoltage Tolerant inputs facilitate 5V to 3V translation
- Patented noise/EMI reduction circuitry implemented

## Ordering Code:

| Product Number | Package Drawing | Product Code Top Mark | Package Description | Supplied As |
|---|---|---|---|---|
| NC7SZ125M5X | MA05B | 7Z25 | 5-Lead SOT23, JEDEC MO-178, 1.6mm | 3k Units on Tape and Reel |
| NC7SZ125M5X_NL (Note 1) | MA05B | 7Z25 | Pb-Free 5-Lead SOT23, JEDEC MO-178, 1.6mm | 3k Units on Tape and Reel |
| NC7SZ125P5X | MAA05A | Z25 | 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3k Units on Tape and Reel |
| NC7SZ125P5X_NL (Note 1) | MAA05A | Z25 | Pb-Free 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3k Units on Tape and Reel |
| NC7SZ125L6X | MAC06A | DD | Pb-Free 6-Lead MicroPak, 1.0mm Wide | 5k Units on Tape and Reel |

Pb-Free package per JEDEC J-STD-020B.

**Note 1:** "_NL" indicates Pb-Free product (per JEDEC J-STD-020B). Device is available in Tape and Reel only.

## Pin Descriptions

| Pin Names | Description |
|---|---|
| A, $\overline{OE}$ | Inputs |
| Y | Output |
| NC | No Connect |

## Function Table

| Inputs | | Output |
|---|---|---|
| $\overline{OE}$ | In A | Out Y |
| L | L | L |
| L | H | H |
| H | X | Z |

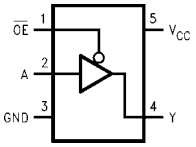
H = HIGH Logic Level
L = LOW Logic Level
X = HIGH or LOW Logic Level
Z = HIGH Impedance State

## Logic Symbol

**IEEE/IEC**

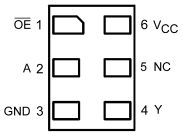

## Connection Diagrams

**Pin Assignment for SC70 and SOT23**




**(Top View)**

**Pad Assignment for MicroPak**




**(Top Thru View)**

## Absolute Maximum Ratings (Note 2)

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | −0.5V to +6V |
| DC Input Voltage ($V_{IN}$) | −0.5V to +6V |
| DC Output Voltage ($V_{OUT}$) | −0.5V to +6V |
| DC Input Diode Current ($I_{IK}$) | |
| @$V_{IN}$ < −0.5V | −50 mA |
| @ $V_{IN}$ > 6V | +20 mA |
| DC Output Diode Current ($I_{OK}$) | |
| @$V_{OUT}$ < −0.5V | −50 mA |
| @ $V_{OUT}$ > 6V, $V_{CC}$ = GND | +20 mA |
| DC Output Current ($I_{OUT}$) | ± 50 mA |
| DC $V_{CC}$/GND Current ($I_{CC}$/$I_{GND}$) | ± 50 mA |
| Storage Temperature ($T_{STG}$) | −65°C to +150°C |
| Junction Temperature under Bias ($T_J$) | 150°C |
| Junction 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 3)

| | |
|---|---|
| Supply Voltage Operating ($V_{CC}$) | 1.65V to 5.5V |
| Supply Voltage Data Retention ($V_{CC}$) | 1.5V to 5.5V |
| Input Voltage ($V_{IN}$) | 0V to 5.5V |
| Output Voltage ($V_{OUT}$) | |
| Active State | 0V to $V_{CC}$ |
| 3-STATE | 0V to 5.5V |
| Operating Temperature ($T_A$) | −40°C to +85°C |
| Input Rise and Fall Time ($t_r$, $t_f$) | |
| $V_{CC}$ = 1.8V, 2.5V ± 0.2V | 0 ns/V to 20 ns/V |
| $V_{CC}$ = 3.3V ± 0.3V | 0 ns/V to 10 ns/V |
| $V_{CC}$ = 5.0V ± 0.5V | 0 ns/V to 5 ns/V |
| Thermal Resistance ($\theta_{JA}$) | |
| SOT23-5 | 300°C/W |
| SC70-5 | 425°C/W |

**Note 2:** Absolute maximum ratings are DC values beyond which the device may be damaged or have its useful life impaired. The datasheet 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 outside datasheet specifications.

**Note 3:** Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

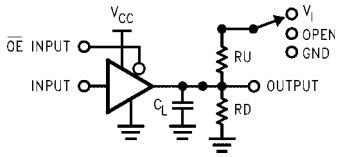
| Symbol | Parameter | $V_{CC}$ | $T_A$ = +25°C | | | $T_A$ = −40°C to +85°C | | Units | Conditions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | (V) | Min | Typ | Max | Min | Max | | | |
| $V_{IH}$ | HIGH Level Input Voltage | 1.65 to 1.95 | 0.75 $V_{CC}$ | | | 0.75 $V_{CC}$ | | V | | |
| | | 2.3 to 5.5 | 0.7 $V_{CC}$ | | | 0.7 $V_{CC}$ | | | | |
| $V_{IL}$ | LOW Level Input Voltage | 1.65 to 1.95 | | | 0.25 $V_{CC}$ | | 0.25 $V_{CC}$ | V | | |
| | | 2.3 to 5.5 | | | 0.3 $V_{CC}$ | | 0.3 $V_{CC}$ | | | |
| $V_{OH}$ | HIGH Level Output Voltage | 1.65 | 1.55 | 1.65 | | 1.55 | | | | |
| | | 1.8 | 1.7 | 1.8 | | 1.7 | | | | |
| | | 2.3 | 2.2 | 2.3 | | 2.2 | | V | $V_{IN}$ = $V_{IH}$ | $I_{OH}$ = −100 μA |
| | | 3.0 | 2.9 | 3.0 | | 2.9 | | | | |
| | | 4.5 | 4.4 | 4.5 | | 4.4 | | | | |
| | | 1.65 | 1.29 | 1.52 | | 1.29 | | | | $I_{OH}$ = −4 mA |
| | | 2.3 | 1.9 | 2.15 | | 1.9 | | | | $I_{OH}$ = −8 mA |
| | | 3.0 | 2.4 | 2.80 | | 2.4 | | V | | $I_{OH}$ = −16 mA |
| | | 3.0 | 2.3 | 2.68 | | 2.3 | | | | $I_{OH}$ = −24 mA |
| | | 4.5 | 3.8 | 4.20 | | 3.8 | | | | $I_{OH}$ = −32 mA |
| $V_{OL}$ | LOW Level Output Voltage | 1.65 | | 0.0 | 0.1 | | 0.0 | | | |
| | | 1.8 | | 0.0 | 0.1 | | 0.1 | | | |
| | | 2.3 | | 0.0 | 0.1 | | 0.1 | V | $V_{IN}$ = $V_{IL}$ | $I_{OL}$ = 100 μA |
| | | 3.0 | | 0.0 | 0.1 | | 0.1 | | | |
| | | 4.5 | | 0.0 | 0.1 | | 0.1 | | | |
| | | 1.65 | | 0.08 | 0.24 | | 0.24 | | | $I_{OL}$ = 4 mA |
| | | 2.3 | | 0.10 | 0.3 | | 0.3 | | | $I_{OL}$ = 8 mA |
| | | 3.0 | | 0.15 | 0.4 | | 0.4 | V | | $I_{OL}$ = 16 mA |
| | | 3.0 | | 0.22 | 0.55 | | 0.55 | | | $I_{OL}$ = 24 mA |
| | | 4.5 | | 0.22 | 0.55 | | 0.55 | | | $I_{OL}$ = 32 mA |
| $I_{IN}$ | Input Leakage Current | 0 to 5.5 | | | ±1 | | ±10 | μA | 0 ≤ $V_{IN}$ ≤ 5.5V | |
| $I_{OZ}$ | 3-STATE Output Leakage | 1.65 to 5.5 | | | ±1 | | ±10 | μA | $V_{IN}$ = $V_{IH}$ or $V_{IL}$<br>0 ≤ $V_O$ ≤ 5.5V | |
| $I_{OFF}$ | Power Off Leakage Current | 0.0 | | | 1 | | 10 | μA | $V_{IN}$ or $V_{OUT}$ = 5.5V | |
| $I_{CC}$ | Quiescent Supply Current | 1.65 to 5.5 | | | 2.0 | | 20 | μA | $V_{IN}$ = 5.5V, 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 | | | |
| $t_{PLH}$ | Propagation Delay | 1.65 | 2.0 | 6.4 | 13.2 | 2.0 | 13.8 | ns | $C_L$ = 15 pF, $R_D$ = 1 MΩ, $S_1$ = OPEN | Figures 1, 3 |
| $t_{PHL}$ | | 1.8 | 2.0 | 5.3 | 11.0 | 2.0 | 11.5 | | | |
| | | 2.5 ± 0.2 | 0.8 | 3.4 | 7.5 | 0.8 | 8.0 | | | |
| | | 3.3 ± 0.3 | 0.5 | 2.5 | 5.2 | 0.5 | 5.5 | | | |
| | | 5.0 ± 0.5 | 0.5 | 2.1 | 4.5 | 0.5 | 4.8 | | | |
| $t_{PLH}$ | Propagation Delay | 3.3 ± 0.3 | 1.5 | 3.2 | 5.7 | 1.5 | 6.0 | ns | $C_L$ = 50 pF, $R_D$ = 500Ω, $S_1$ = OPEN | Figures 1, 3 |
| $t_{PHL}$ | | 5.0 ± 0.5 | 0.8 | 2.6 | 5.0 | 0.8 | 5.3 | | | |
| $t_{PZL}$ | Output Enable Time | 1.65 | 2.0 | 8.4 | 15.0 | 2.0 | 15.6 | ns | $C_L$ = 50 pF, RD = 500Ω RU = 500Ω $S_1$ = GND for $t_{PZH}$ $S_1$ = $V_{IN}$ for $t_{PZL}$ $V_{IN}$ = 2 x $V_{CC}$ | Figures 1, 3 |
| $t_{PZH}$ | | 1.8 | 2.0 | 7.0 | 12.5 | 2.0 | 13 | | | |
| | | 2.5 ± 0.2 | 1.5 | 4.6 | 8.5 | 1.5 | 9 | | | |
| | | 3.3 ± 0.3 | 1.5 | 3.5 | 6.2 | 1.5 | 6.5 | | | |
| | | 5.0 ± 0.5 | 0.8 | 2.8 | 5.5 | 0.8 | 5.8 | | | |
| $t_{PLZ}$ | Output Disable Time | 1.65 | 2.0 | 6.5 | 13.2 | 2.0 | 14.5 | ns | $C_L$ = 50 pF, RD = 500Ω RU = 500Ω $S_1$ = GND for $t_{PHZ}$ $S_1$ = $V_{IN}$ for $t_{PLZ}$ $V_{IN}$ = 2 x $V_{CC}$ | Figures 1, 3 |
| $t_{PHZ}$ | | 1.8 | 2.0 | 5.4 | 11 | 2.0 | 12 | | | |
| | | 2.5 ± 0.2 | 1.5 | 3.5 | 8 | 1.5 | 8.5 | | | |
| | | 3.3 ± 0.3 | 1.0 | 2.8 | 5.7 | 1.0 | 6 | | | |
| | | 5.0 ± 0.5 | 0.5 | 2.1 | 4.7 | 0.5 | 5.0 | | | |
| $C_{IN}$ | Input Capacitance | 0 | | 4 | | | | pF | | |
| $C_{OUT}$ | Output Capacitance | 0 | | 8 | | | | | | |
| $C_{PD}$ | Power Dissipation Capacitance | 3.3 | | 17 | | | | pF | (Note 4) | Figure 2 |
| | | 5.0 | | 24 | | | | | | |

**Note 4:** $C_{PD}$ 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: $I_{CCD} = (C_{PD})(V_{CC})(f_{IN}) + (I_{CC}static)$.

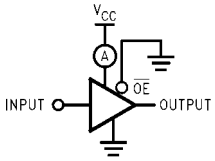
## AC Loading and Waveforms




$C_L$ includes load and stray capacitance

Input PRR = 1.0 MHz; $t_W$ = 500 ns

**FIGURE 1. AC Test Circuit**




Input = AC Waveform; $t_r = t_f$ = 1.8 ns;

PRR = 10 MHz; Duty Cycle = 50%

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

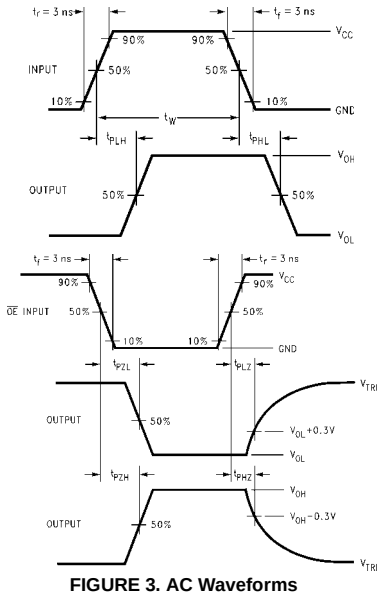


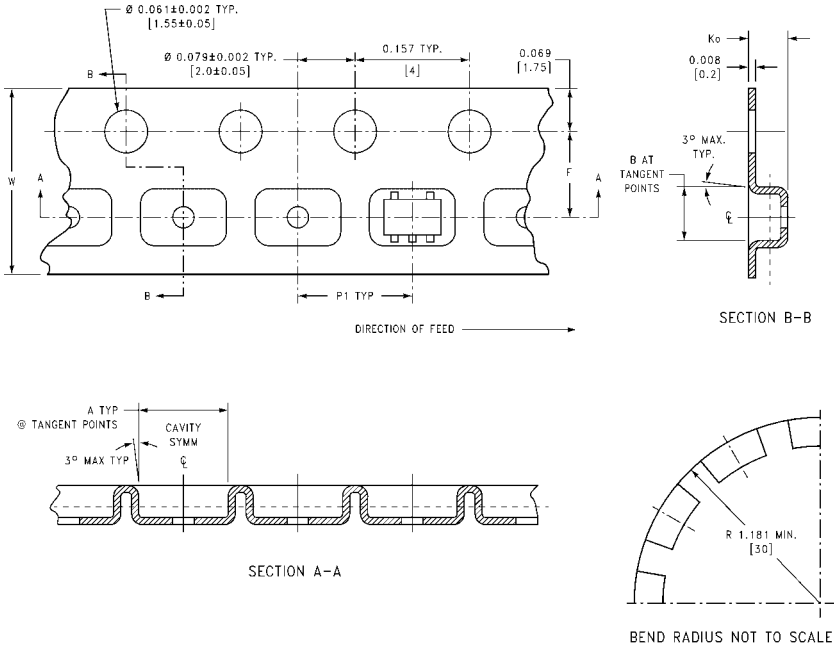

**FIGURE 3. AC Waveforms**

## 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)



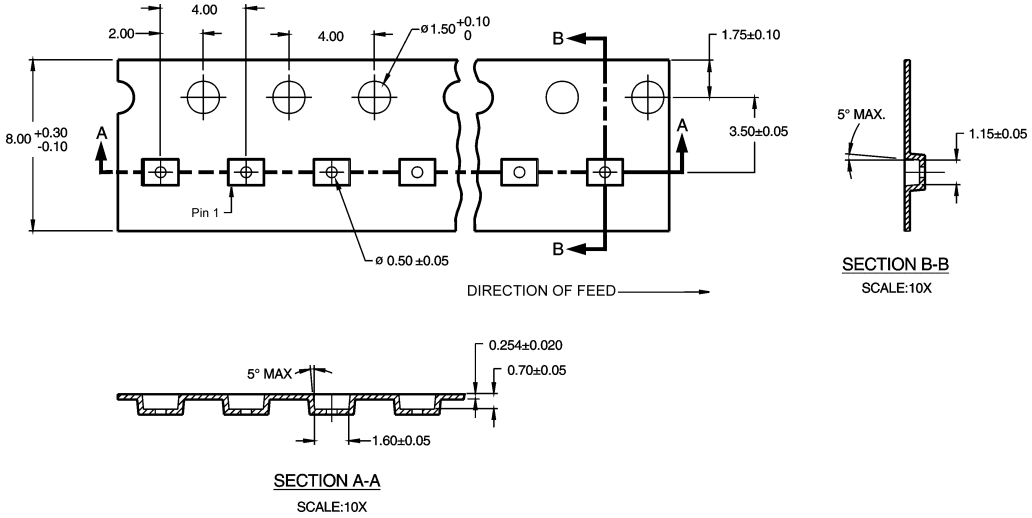

| Package | Tape Size | DIM A | DIM B | DIM F | DIM $K_o$ | DIM P1 | DIM W |
|---|---|---|---|---|---|---|---|
| SC70-5 | 8 mm | 0.093 (2.35) | 0.096 (2.45) | 0.138 ± 0.004 (3.5 ± 0.10) | 0.053 ± 0.004 (1.35 ± 0.10) | 0.157 (4) | 0.315 ± 0.004 (8 ± 0.1) |
| SOT23-5 | 8 mm | 0.130 (3.3) | 0.130 (3.3)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

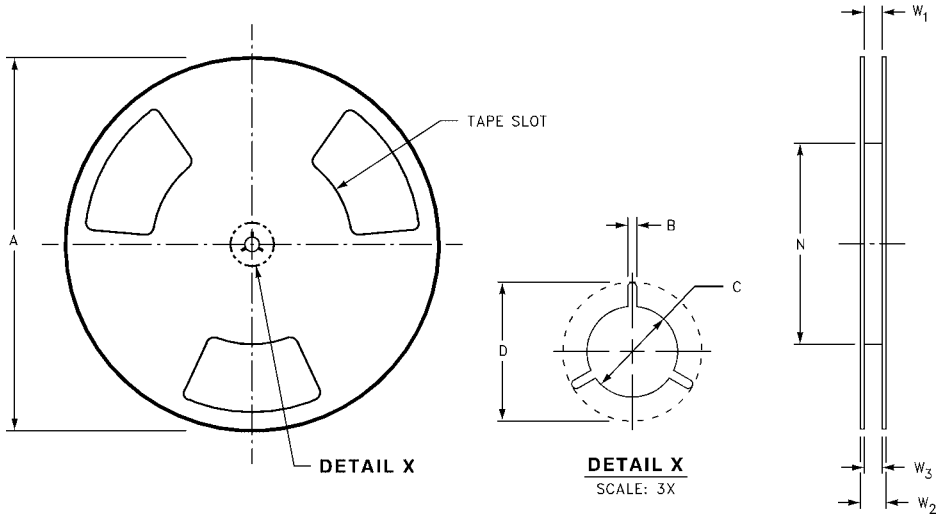
**TAPE FORMAT FOR MicroPak**

| 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 |

**TAPE DIMENSIONS** inches (millimeters)

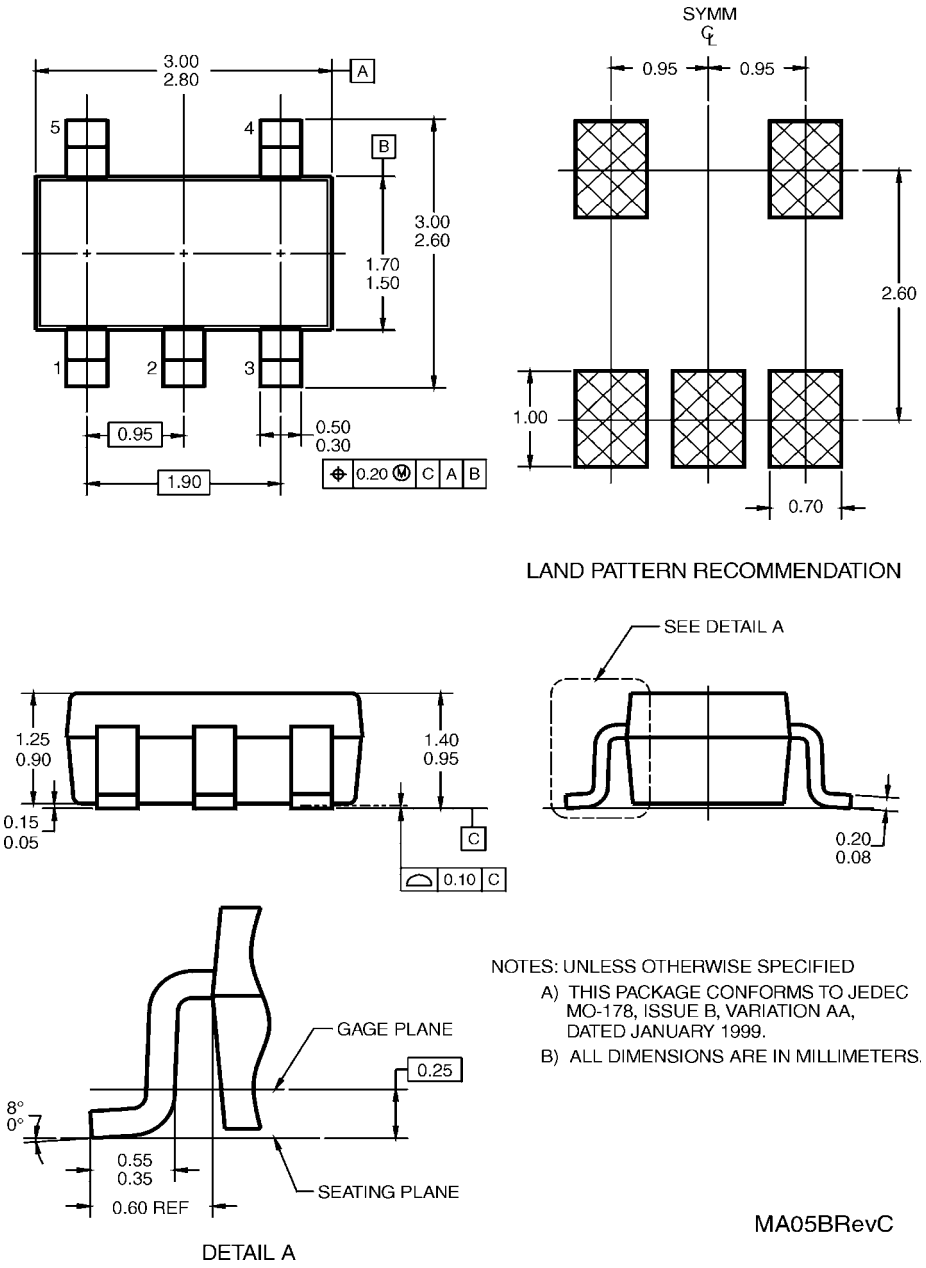



**REEL DIMENSIONS** inches (millimeters)




| 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

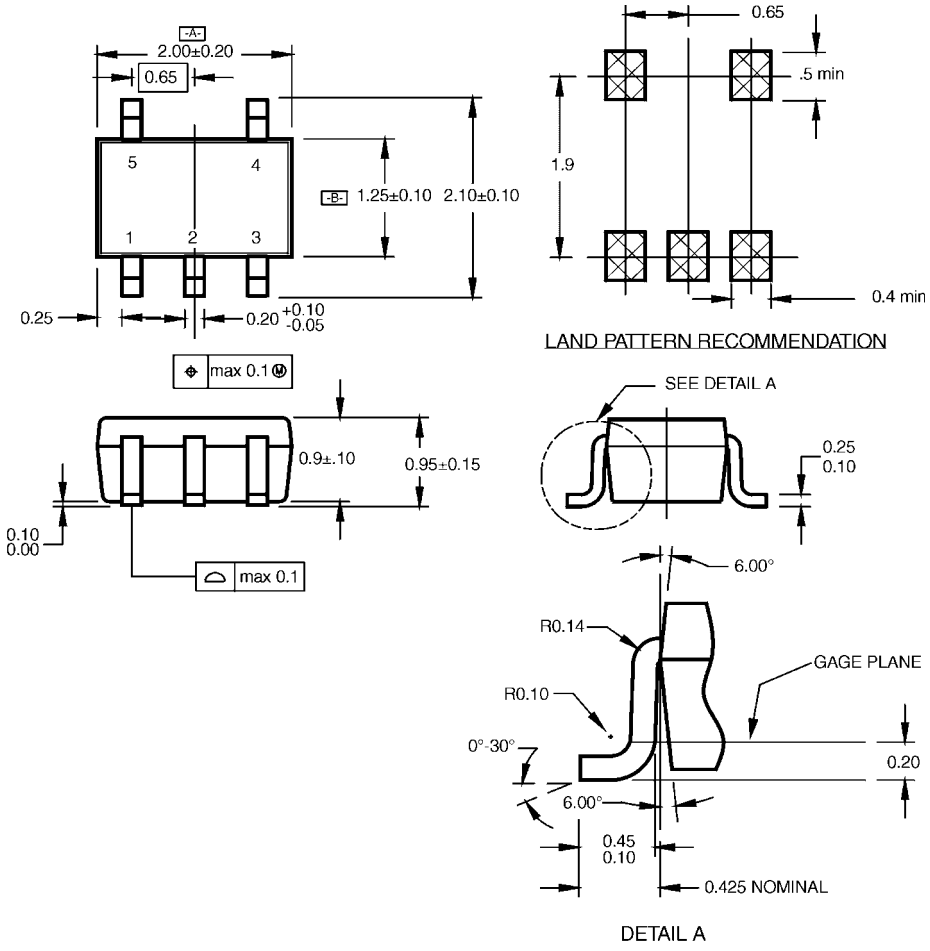
A) THIS PACKAGE CONFORMS TO JEDEC MO-178, ISSUE B, VARIATION AA, DATED JANUARY 1999.

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)



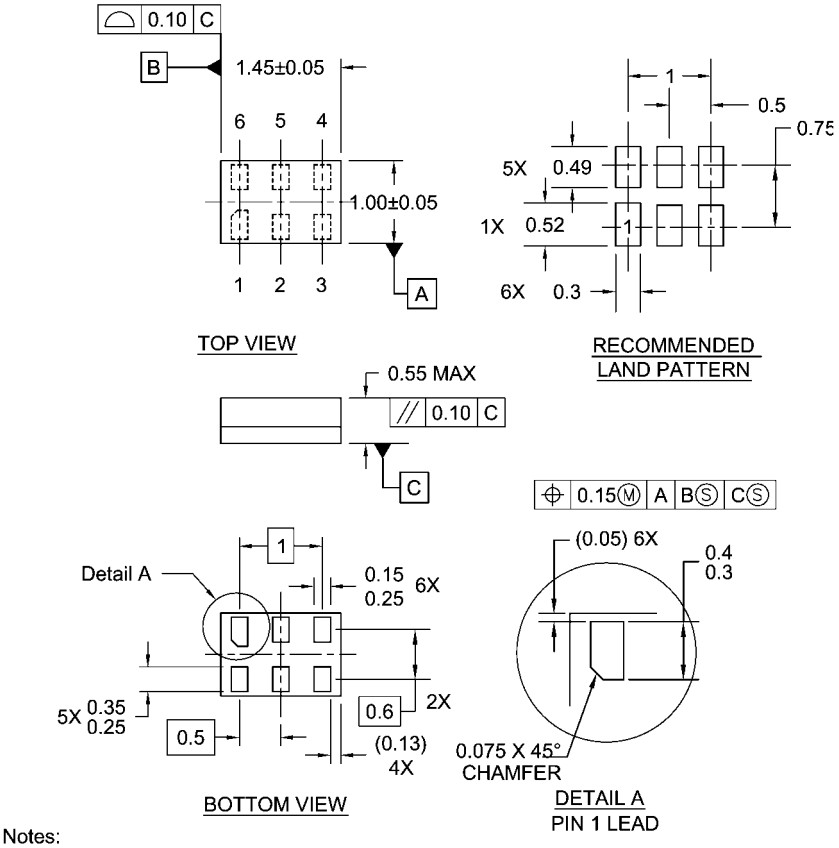

NOTES:

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

**Pb-Free 6-Lead MicroPak, 1.0mm Wide**
**Package Number MAC06A**