November 2002
Revised August 2003

# FSA66
# Low Voltage UHS Single SPST Normally Open Analog Switch

## General Description

The FSA66 is a ultra high-speed (UHS) CMOS compatible single-pole/single-throw (SPST) analog switch. The LOW On Resistance of the switch allows input to be connected to output with minimal propagation delay and without generating additional ground bounce noise. The device is organized as a 1-bit switch with a switch enable (OE) signal. When OE is HIGH, the switch is on and Port A is connected to Port B. When OE is LOW, the switch is open and a high-impedance state exists between the two ports.

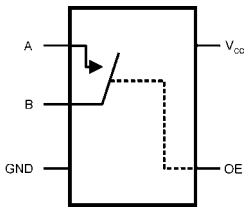
## Features

- Space saving SOT23 or SC70 5-lead package
- Ultra small MicroPak™ leadless package
- Broad $V_{CC}$ Operating Range 1.65V–5.5V
- Rail-to-Rail signal handling
- 5Ω switch connection between two ports
- Minimal propagation delay through the switch
- Low $I_{CC}$
- Zero bounce in flow-through mode
- Control input compatible with CMOS input levels
- >250 MHz –3dB bandwidth

## Ordering Code:

| Order Number | Package Number | Product Code Top Mark | Package Description | Supplied As |
|---|---|---|---|---|
| FSA66M5X | MA05B | 7Z66 | 5-Lead SOT23, JEDEC MO-178, 1.6mm | 3k Units on Tape and Reel |
| FSA66P5X | MAA05A | Z66 | 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3k Units on Tape and Reel |
| FSA66L6X | MAC06 | EE | 6-Lead MicroPak, 1.0mm Wide | 5k Units on Tape and Reel |

## Analog Symbol




## Pin Descriptions

| Pin Names | Description |
|---|---|
| OE | Switch Enable Input |
| A | Bus A I/O |
| B | Bus B I/O |
| NC | No Connect |

## Function Table

| OE | $B_0$ | Function |
|---|---|---|
| L | HIGH-Z State | Disconnect |
| H | $A_0$ | Connect |

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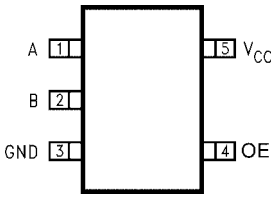
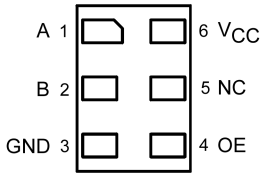
## Connection Diagrams

**Pin Assignments for SC70**




**(Top View)**

**Pad Assignment for MicroPak**




**(Top Through View)**

## Absolute Maximum Ratings (Note 1)

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | –0.5V to +7.0V |
| DC Switch Voltage ($V_S$) | –0.5V to $V_{CC}$ +0.5V |
| DC Input Voltage ($V_{IN}$) (Note 2) | –0.5V to +7.0V |
| DC Input Diode Current ($I_{IK}$) $V_{IN}$ < 0V | –50 mA |
| DC Output ($I_{OUT}$) Sink Current | 128 mA |
| DC $V_{CC}$/GND Current ($I_{CC}$/$I_{GND}$) | ±100 mA |
| Storage Temperature Range ($T_{STG}$) | –65°C to +150°C |
| Junction Lead 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)

| | |
|---|---|
| Power Supply Operating ($V_{CC}$) | 1.65V to 5.5V |
| Control Input Voltage ($V_{IN}$) | 0V to 5.5V |
| Switch Input Voltage ($V_{IN}$) | 0V to $V_{CC}$ |
| Switch Output Voltage ($V_{OUT}$) | 0V to $V_{CC}$ |
| Input Rise and Fall Time ($t_r$, $t_f$) | |
| Control Input; $V_{CC}$ = 2.3V–3.6V | 0 ns/V to 10 ns |
| Control Input; $V_{CC}$ = 4.5–5.5V | 0 ns/V to 5 ns |
| Switch I/O | 0 ns/V to DC |
| Operating Temperature ($T_A$) | –40°C to +85°C |
| Thermal Resistance ($\theta_{JA}$) | |
| SOT23-5 | 300°C/Watt |
| SC70-5 | 425°C/Watt |

**Note 1:** The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Note 2:** The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

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

## DC Electrical Characteristics

| Symbol | Parameter | $V_{CC}$ (V) | $T_A$ = –40°C to +85°C | | | $T_A$ = +25°C | | | Units | Conditions |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ (Note 5) | Max | Min | Typ | Max | | |
| $V_{IH}$ | HIGH Level Input Voltage | 1.65 to 1.95 | 0.75 $V_{CC}$ | | | | | | V | |
| | | 2.3 to 5.5 | 0.7 $V_{CC}$ | | | | | | | |
| $V_{IL}$ | LOW Level Input Voltage | 1.65 to 1.95 | | | 0.25 $V_{CC}$ | | | | V | |
| | | 2.3 to 5.5 | | | 0.3 $V_{CC}$ | | | | | |
| $I_{IN}$ | Control Input Leakage Current | 0 to 5.5 | | ±0.05 | ±1.0 | | | | µA | 0 ≤ $V_{IN}$ ≤ 5.5V |
| $I_{OFF}$ | OFF Leakage Current | 1.65 to 5.5 | | ±0.05 | ±10.0 | | | | µA | 0 ≤ A, B ≤ $V_{CC}$ |
| $R_{ON}$ | Switch On Resistance (Note 4) | 4.5 | | 3 | 7 | | | | Ω | $V_{IN}$ = 0V, $I_{IN}$ = 30 mA |
| | | | | 5 | 12 | | | | | $V_{IN}$ = 2.4V, $I_{IN}$ = 15 mA |
| | | | | 7 | 15 | | | | | $V_{IN}$ = 4.5V, $I_{IN}$ = 30 mA |
| | | 3.0 | | 4 | 9 | | | | | $V_{IN}$ = 0V, $I_{IN}$ = 24 mA |
| | | | | 10 | 20 | | | | | $V_{IN}$ = 3V, $I_{IN}$ = 24 mA |
| | | 2.3 | | 5 | 12 | | | | | $V_{IN}$ = 0V, $I_{IN}$ = 8 mA |
| | | | | 13 | 30 | | | | | $V_{IN}$ = 2.3V, $I_{IN}$ = 8 mA |
| | | 1.8 | | 7 | 28 | | | | | $V_{IN}$ = 0V, $I_{IN}$ = 4 mA |
| | | | | 25 | 60 | | | | | $V_{IN}$ = 1.8V, $I_{IN}$ = 4 mA |
| $R_{flat}$ | On Resistance Flatness (Note 4)(Note 6)(Note 7) | 5.0 | | | | | 6 | | Ω | $I_A$ = –30 mA, 0 ≤ $V_{Bn}$ ≤ $V_{CC}$ |
| | | 3.3 | | | | | 12 | | | $I_A$ = –24 mA, 0 ≤ $V_{Bn}$ ≤ $V_{CC}$ |
| | | 2.5 | | | | | 28 | | | $I_A$ = –8 mA, 0 ≤ $V_{Bn}$ ≤ $V_{CC}$ |
| | | 1.8 | | | | | 125 | | | $I_A$ = –4 mA, 0 ≤ $V_{Bn}$ ≤ $V_{CC}$ |
| $I_{CC}$ | Quiescent Supply Current | 1.65 to 5.5 | | 0.05 | 10 | | | | µA | $V_{IN}$ = $V_{CC}$ or GND $I_{OUT}$ = 0 |

**Note 4:** Measured by the voltage drop between A and B pins at the indicated current through the switch. On Resistance is determined by the lower of the voltages on the two (A or B) pins.

**Note 5:** All typical values are at the specified $V_{CC}$, and $T_A$ = 25°C.

**Note 6:** Parameter is characterized but not tested in production.

**Note 7:** Flatness is defined as the difference between the maximum and minimum value of On Resistance over the specified range of conditions.

## AC Electrical Characteristics

| Symbol | Parameter | $V_{CC}$ (V) | $T_A = -40°C$ to $+85°C$, $C_L = 50$ pF, RU = RD = 500Ω | | | Units | Conditions | Figure Number |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ (Note 8) | Max | | | |
| $t_{PHL}$, $t_{PLH}$ | Propagation Delay Bus to Bus (Note 9) | 1.65 to 1.95 | | | 4.3 | | $V_{IN}$ = OPEN | Figures 1, 2 |
| | | 2.3-2.7 | | | 1.2 | ns | | |
| | | 3.0-3.6 | | | 0.8 | ns | | |
| | | 4.5-5.5 | | | 0.3 | ns | | |
| $t_{PZL}$, $t_{PZH}$ | Output Enable Time | 1.65 to 1.95 | 1.5 | 7.0 | 14.2 | | $V_{IN}$ = 2 x $V_{CC}$ for $t_{PZL}$<br>$V_{IN}$ = 0V for $t_{PZH}$ | Figures 1, 2 |
| | | 2.3-2.7 | 1.5 | 3.3 | 7.0 | ns | | |
| | | 3.0-3.6 | 1.5 | 2.4 | 5.5 | ns | | |
| | | 4.5-5.5 | 1.5 | 2.0 | 4.5 | ns | | |
| $t_{PLZ}$, $t_{PHZ}$ | Output Disable Time | 1.65 to 1.95 | 1.5 | 9.2 | 18.2 | | $V_{IN}$= 2 x $V_{CC}$ for $t_{PLZ}$<br>$V_{IN}$ = 0V for $t_{PHZ}$ | Figures 1, 2 |
| | | 2.3-2.7 | 1.5 | 5.3 | 9.0 | ns | | |
| | | 3.0-3.6 | 1.5 | 4.0 | 7.0 | ns | | |
| | | 4.5-5.5 | 1.5 | 2.7 | 5.0 | ns | | |
| Q | Charge Injection (Note 10) | 1.65-5.5 | | 0.05 | | pC | $C_L$ = 0.1 nF, $V_{GEN}$ = 0V, $R_{GEN}$ = 0Ω, f = 1 MHz | Figure 3 |
| OIRR | Off Isolation (Note 11) | 1.65-5.5 | | −50 | | dB | $R_L$ = 50 Ω, $C_L$ = 5 pF, f = 10 MHz | Figure 4 |
| BW | −3dB Bandwidth | 1.65-5.5 | | >250 | | MHz | $R_L$ = 50 Ω | Figure 5 |
| THD | Total Harmonic Distortion (Note 8) | 5 | | .011 | | % | $R_L$ = 600Ω<br>0.5 $V_{P-P}$<br>f = 600 Hz to 20 KHz | |

**Note 8:** All typical values are at the specified $V_{CC}$, and $T_A = 25°C$.

**Note 9:** This parameter is guaranteed by design but is not tested. The switch contributes no propagation delay other than the RC delay of the typical On Resistance of the switch and the 50 pF load capacitance, when driven by an ideal voltage source (zero output impedance).

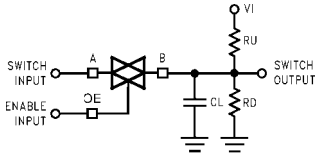
**Note 10:** Guaranteed by design.

**Note 11:** Off Isolation = 20 $\log_{10}$ [$V_A/V_{BN}$].

## Capacitance

| Symbol | Parameter | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|
| $C_{IN}$ | Control Pin Input Capacitance | 2 | | pF | $V_{CC}$ = 0V |
| $C_{I/O}$ | Input/Output Capacitance | 6 | | pF | $V_{CC}$ = 5.0V |

## AC Loading and Waveforms




Input driven by 50Ω source terminated in 50Ω

$C_L$ includes load and stray capacitance.

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

**FIGURE 1. AC Test Circuit**

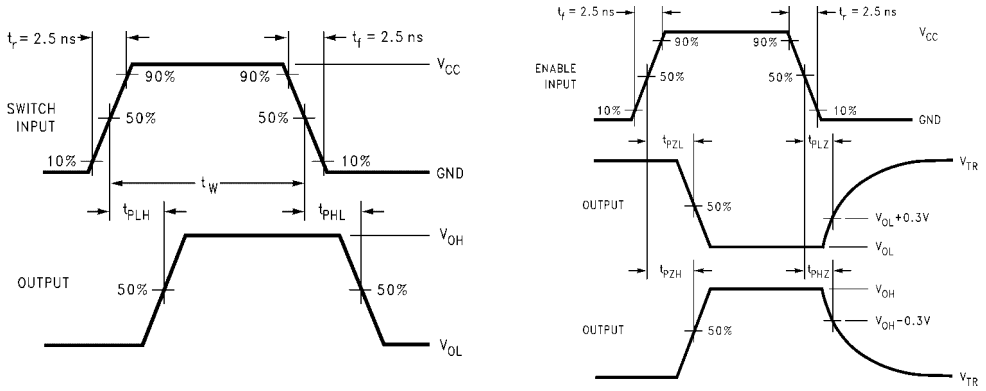



**FIGURE 2. AC Waveforms**

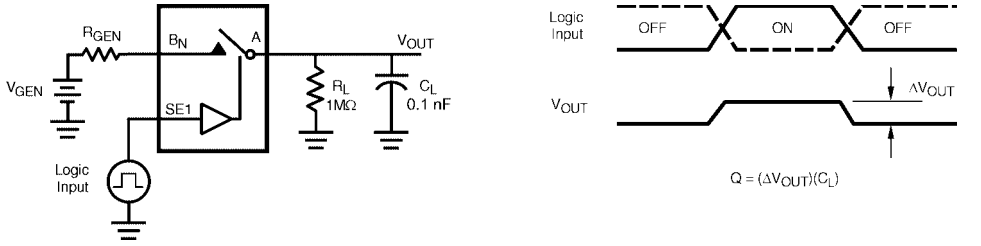



**FIGURE 3. Charge Injection Test**

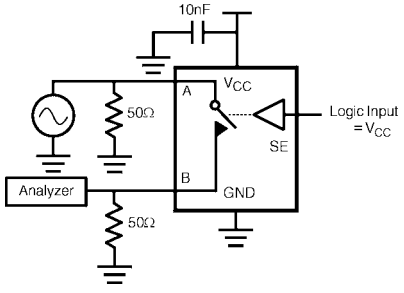



**FIGURE 4. Off Isolation**

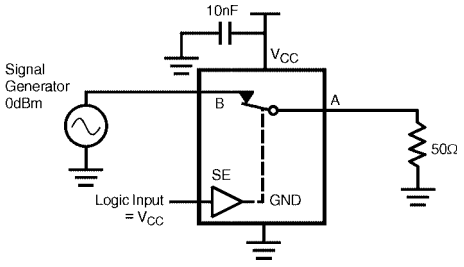


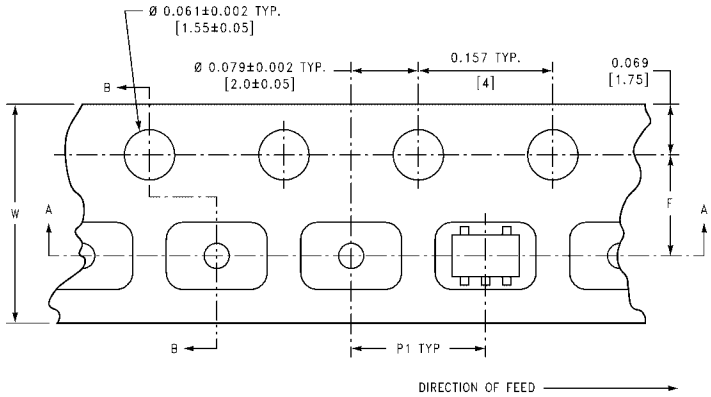

**FIGURE 5. Bandwidth**

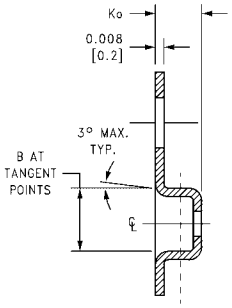
# Tape and Reel Specification

**TAPE FORMAT FOR SOT23, SC70**

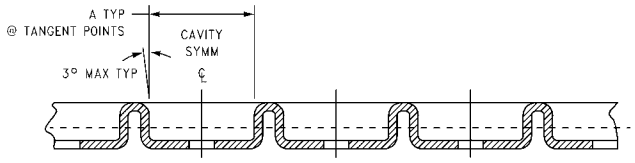
| Package Designator | Tape Section | Number Cavities | Cavity Status | Cover Tape Status |
|---|---|---|---|---|
| M5X, P5X | Leader (Start End) | 125 (typ) | Empty | Sealed |
| | Carrier | 3000 | Filled | Sealed |
| | Trailer (Hub End) | 75 (typ) | Empty | Sealed |

**TAPE DIMENSIONS** inches (millimeters)

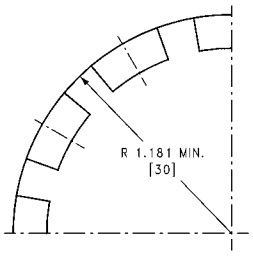



SECTION B-B




SECTION A-A




BEND RADIUS NOT TO SCALE

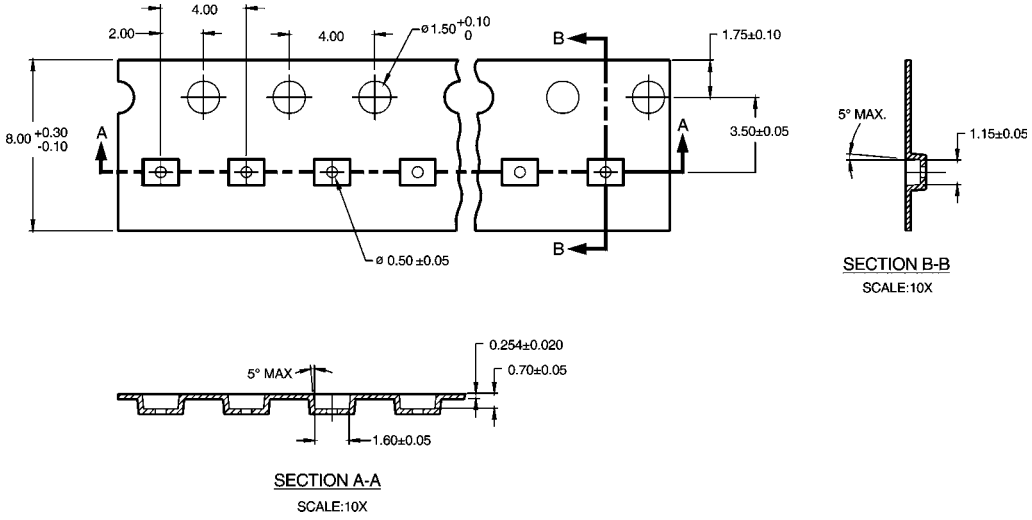
| Package | Tape Size | DIM A | DIM B | DIM F | DIM $K_o$ | DIM P1 | DIM W |
|---|---|---|---|---|---|---|---|
| SC70-5 | 8 mm | 0.093<br>(2.35) | 0.096<br>(2.45) | 0.138 ± 0.004<br>(3.5 ± 0.10) | 0.053 ± 0.004<br>(1.35 ± 0.10) | 0.157<br>(4) | 0.315 ± 0.004<br>(8 ± 0.1) |
| SOT23-5 | 8 mm | 0.130<br>(3.3)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

## Tape and Reel Specification (Continued)

**TAPE FORMAT FOR MicroPak**

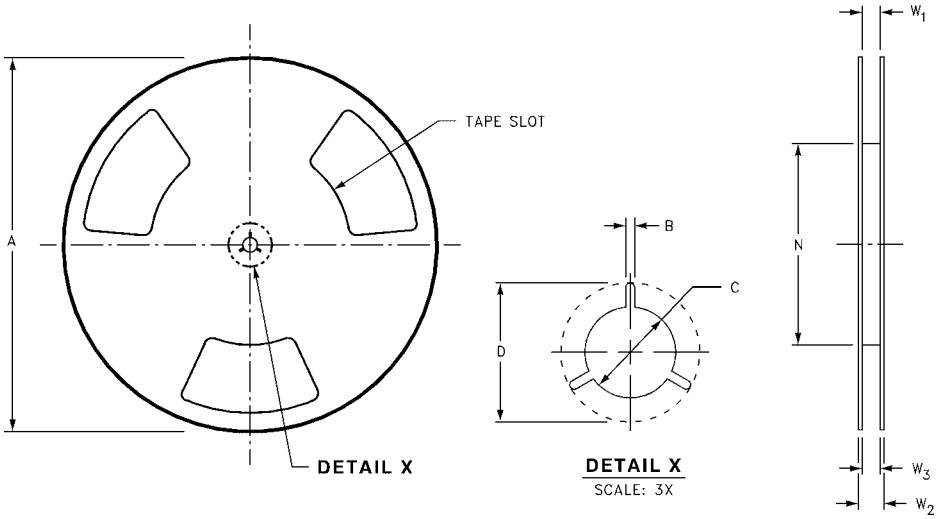
| Package Designator | Tape Section | Number Cavities | Cavity Status | Cover Tape Status |
|---|---|---|---|---|
| L6X | Leader (Start End) | 125 (typ) | Empty | Sealed |
| | Carrier | 5000 | Filled | Sealed |
| | Trailer (Hub End) | 75 (typ) | Empty | Sealed |

**TAPE DIMENSIONS** inches (millimeters)



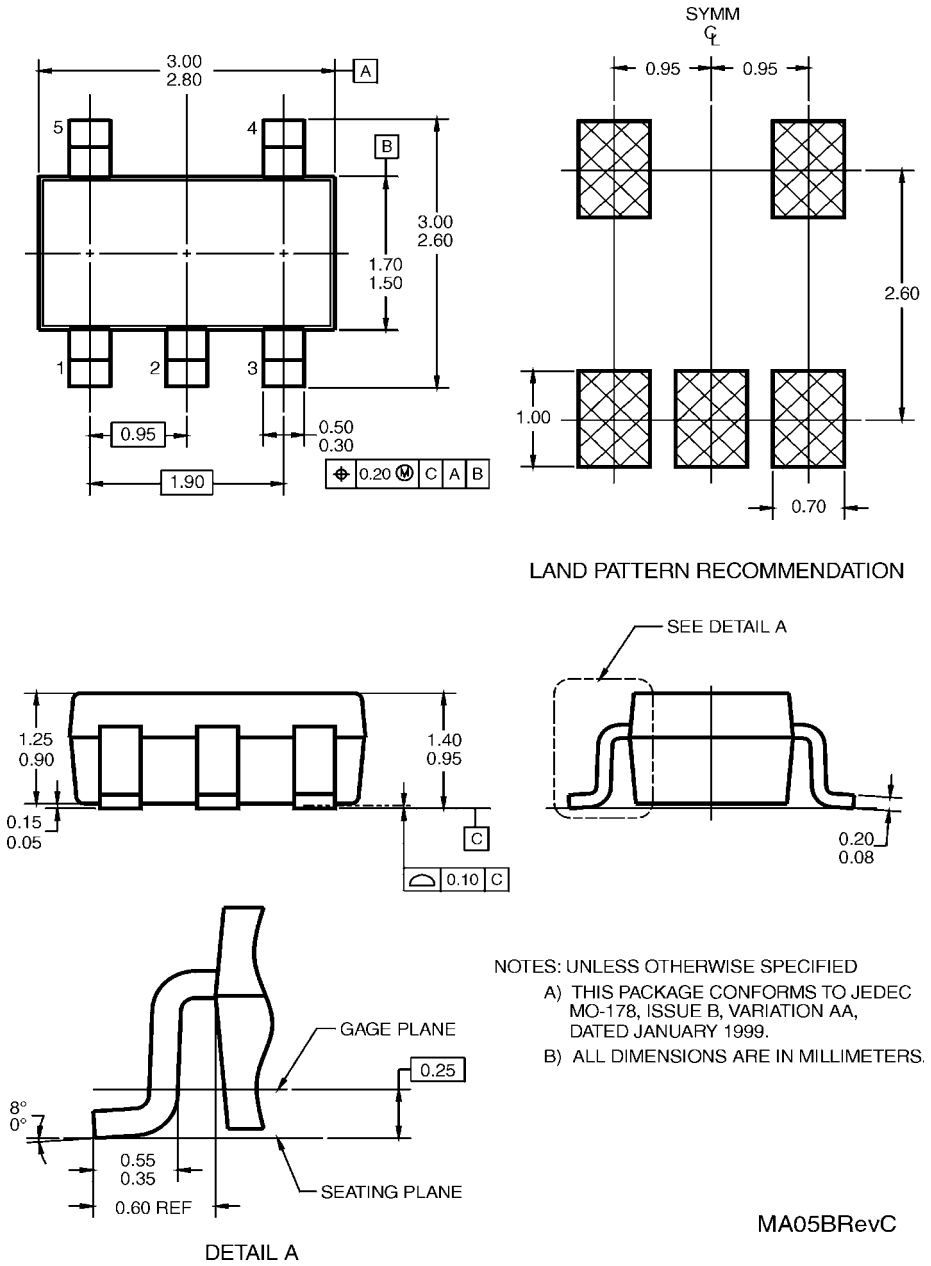
## Tape and Reel Specification (Continued)

**REEL DIMENSIONS** inches (millimeters)



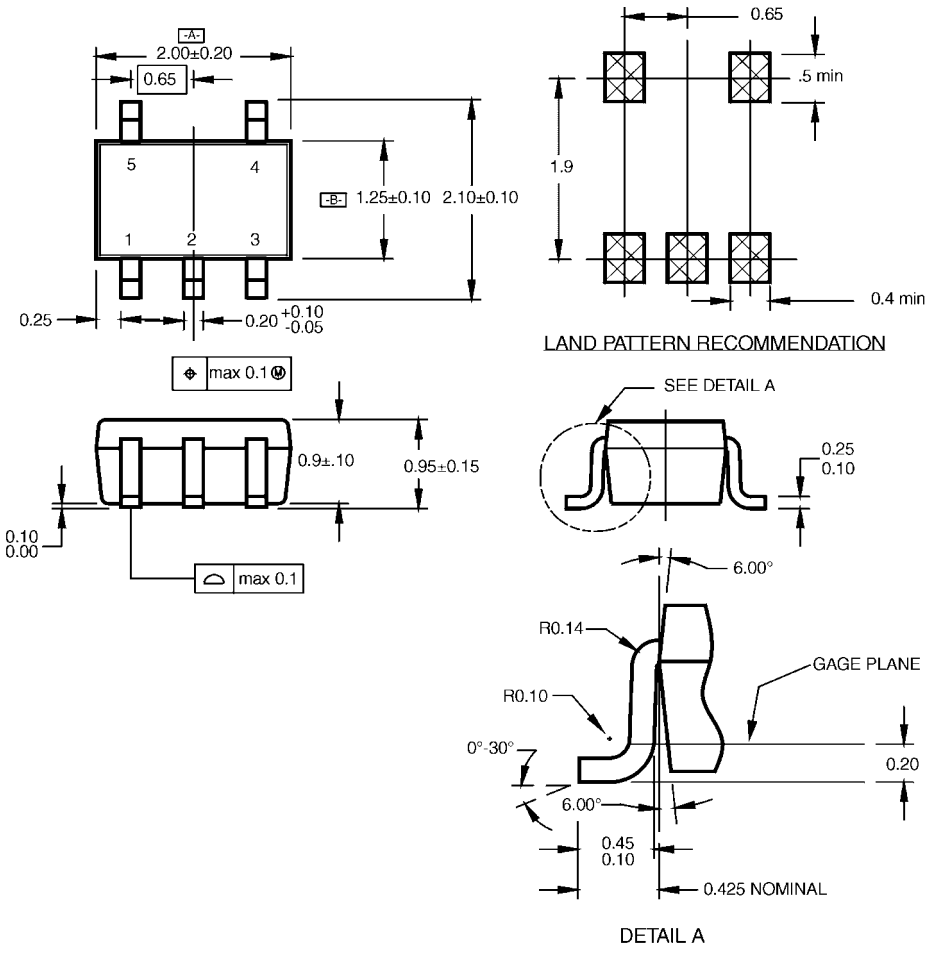

| Tape Size | A | B | C | D | N | W1 | W2 | W3 |
|---|---|---|---|---|---|---|---|---|
| 8 mm | 7.0<br>(177.8) | 0.059<br>(1.50) | 0.512<br>(13.00) | 0.795<br>(20.20) | 2.165<br>(55.00) | 0.331 + 0.059/–0.000<br>(8.40 + 1.50/–0.00) | 0.567<br>(14.40) | W1 + 0.078/–0.039<br>(W1 + 2.00/–1.00) |

## 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)



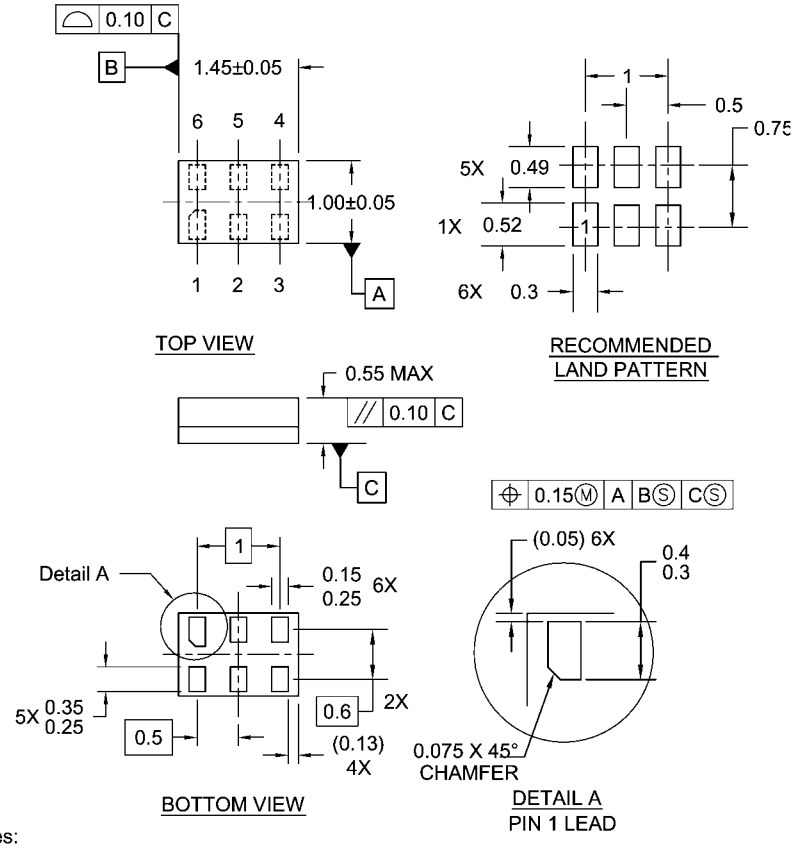

NOTES:

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**