

FSA5157

0.4Ω Low Voltage SPDT Analog Switch (Preliminary)

General Description

The FSA5157 is a low ON Resistance, low power Single Pole Double Throw (SPDT) analog switch. This product has been designed for switching audio signals in applications such as cell phones and portable media players. The ultra-low 0.4 Ohm impedance, sub 1μA current consumption, and 1.65V to 4.3V operating voltage range makes this product ideal for battery power applications. The FSA5157 also features bi-directional operation and make-before-break functionality. This device is fully specified for operation at 1.8V, 2.5V and 3.3V.

A growing number of applications require the voltage applied to the select input to be lower than the V_{CC} applied. Under this condition, most switches would typically consume over 100μA of current. This would be an unacceptable level for battery powered applications. The FSA5157 has been designed to minimize current consumption under this condition. The I_{CCT} is specified for <12μA under a worse case condition of $V_{CC} = 4.3V$ and $V_{IN} = 1.8V$.

Features

- Typical 0.4Ω On Resistance (R_{ON}) for +2.7V supply
- FSA5157 features less than 12μA I_{CCT} current when S input is lower than V_{CC}
- 0.25Ω maximum R_{ON} flatness for +2.7V supply
- 1.0mm x 1.45mm 6-Lead Pb-Free MicroPak™ package
- Broad V_{CC} operating range: 1.65V to 4.3V
- Low THD (0.02% typical for 32Ω load)
- High current handling capability (350mA continuous current under 3.3V supply)
- Control logic is 1.8V CMOS logic compatible

Applications

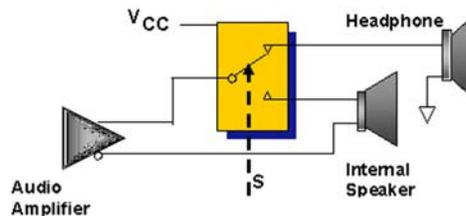
- Cellular phone
- PDA
- Portable Media Player

Ordering Code:

Order Number	Package Number	Product Code Top Mark	Package Description	Supplied As
FSA5157P6X	MAA06A	A57	6-Lead SC70, EIAJ SC88, 1.25mm Wide	3K Units on Tape and Reel
FSA5157P6X_NL	MAA06A	A57	Pb-Free 6-Lead SC70, EIAJ SC88, 1.25mm Wide	3K Units on Tape and Reel
FSA5157L6X	MAC06A	FT	Pb-Free 6-Lead MicroPak, 1.0mm Wide	5K Units on Tape and Reel

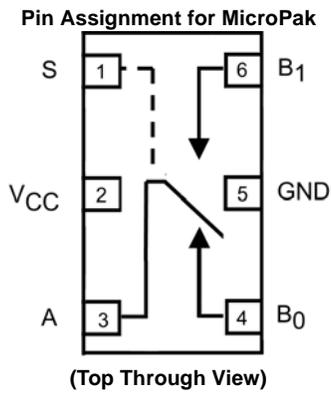
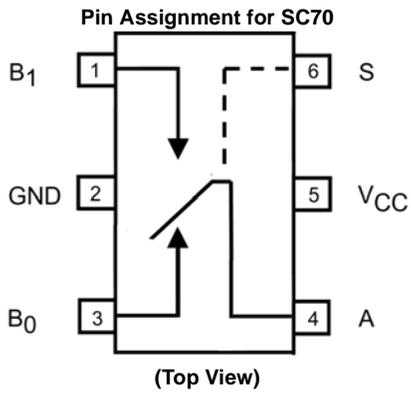
Pb-Free package per JEDEC J-STD-020B.

Applications Diagram



MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

Analog Symbols



Truth Table

Control Input(s)	Function
L	B ₀ Connected to A
H	B ₁ Connected to A

H = HIGH Logic Level
L = LOW Logic Level

Pin Descriptions

Pin Names	Function
A, B ₀ , B ₁	Data Ports
S	Control Input

Absolute Maximum Ratings(Note 1)

Supply Voltage (V_{CC})	-0.5V to +4.6V
Switch Voltage (V_S) (Note 2)	-0.5V to $V_{CC} + 3.0V$
Input Voltage (V_{IN}) (Note 2)	-0.5V to +4.6V
Input Diode Current	-50 mA
Switch Current	350 mA
Peak Switch Current (Pulsed at 1 ms duration, <10% Duty Cycle)	500 mA
Storage Temperature Range (T_{STG})	-65°C to +150°C
Maximum Junction Temperature (T_J)	+150°C
Lead Temperature (T_L)	
Soldering, 10 seconds	+260°C
ESD	
Human Body Model	8000V

Recommended Operating Conditions

Supply Voltage (V_{CC})	1.65V to 4.3V
Control Input Voltage (V_{IN}) (Note 3)	0V to V_{CC}
Switch Input Voltage (V_{IN})	0V to V_{CC}
Operating Temperature (T_A)	-40°C to +85°C

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 (All typical values are @ 25°C unless otherwise specified)

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}	Input Voltage High	3.6 to 4.3				1.4		V	
		2.7 to 3.6				1.3			
		2.3 to 2.7				1.1			
		1.65 to 1.95				0.9			
V_{IL}	Input Voltage Low	3.6 to 4.3					0.7	V	
		2.7 to 3.6					0.5		
		2.3 to 2.7					0.4		
		1.65 to 1.95					0.4		
I_{IN}	Control Input Leakage	1.65 to 4.3				-0.5	0.5	μA	$V_{IN} = 0V$ to V_{CC}
$I_{NO(OFF)}$, $I_{NC(OFF)}$	OFF-Leakage Current of Port B_0 and B_1	1.95 to 4.3	-10.0		10.0	-50.0	50.0	nA	$A = 0.3V$, $V_{CC} = 0.3V$ B_0 or $B_1 = 0.3V$, $V_{CC} = 0.3V$ or Floating
$I_{A(ON)}$	ON Leakage Current of Port A	1.95 to 4.3	-20.0		20.0	-100	100	nA	$A = 0.3V$, $V_{CC} = 0.3V$ B_0 or $B_1 = 0.3V$, $V_{CC} = 0.3V$ or Floating
R_{ON}	Switch On Resistance (Note 4)	4.3		0.36			0.6	Ω	$I_{OUT} = 100$ mA, B_0 or $B_1 = 0.7V$, $3.6V$ B_0 or $B_1 = 0V$, $0.7V$, $3.6V$, $4.3V$
		2.7		0.4			0.7		$I_{OUT} = 100$ mA, B_0 or $B_1 = 0V$, $0.7V$, $2.0V$, $2.7V$
		2.3		0.55			0.8		$I_{OUT} = 100$ mA, $0V$ or Delete $0.7V$, $2.0V$, $2.3V$
		1.65		1.5	2.5		3.0		$I_{OUT} = 100$ mA, B_0 or $B_1 = 0.7V$
ΔR_{ON}	On Resistance Matching Between Channels (Note 5)	4.3		0.04			0.75	Ω	$I_{OUT} = 100$ mA, B_0 or $B_1 = 0.7V$
		2.7		0.06			0.13		
		2.3		0.12			0.2		
		1.65		1.0					
$R_{FLAT(ON)}$	On Resistance Flatness (Note 6)	4.3					0.25	Ω	$I_{OUT} = 100$ mA, B_0 or $B_1 = 0V$ to V_{CC}
		2.7					0.25		
		2.3					0.3		
		1.65		0.3					
I_{CC}	Quiescent Supply Current	4.3	-100.0	30.0	100.0	-500	500	nA	$V_{IN} = 0V$ or V_{CC} , $I_{OUT} = 0V$
I_{CCT}	Increase in I_{CC} per Control Input	4.3		7.0	12.0		15.0	μA	$V_{IN} = 1.8$
				3.0	6.0		7.0		$V_{IN} = 2.6$

DC Electrical Characteristics (Continued)

Note 4: On Resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.

Note 5: $\Delta R_{ON} = R_{ONmax} - R_{ONmin}$ measured at identical V_{CC} , temperature, and voltage.

Note 6: Flatness is defined as the difference between the maximum and minimum value of On Resistance over the specified range of conditions.

AC Electrical Characteristics (All typical value are @ 25°C unless otherwise specified)

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 _{ON}	Turn ON Time	3.6 to 4.3			55.0		60.0	ns	B ₀ or B ₁ = 1.5V, R _L = 50Ω, C _L = 35 pF	Figure 4
		2.7 to 3.6			60.0		65.0			
		2.3 to 2.7			65.0		70.0			
		1.65 to 1.95		70.0			90.0			
t _{OFF}	Turn OFF Time	3.6 to 4.3			30.0		35.0	ns	B ₀ or B ₁ = 1.5V, R _L = 50Ω, C _L = 35 pF	Figure 4
		2.7 to 3.6			35.0		40.0			
		2.3 to 2.7			40.0		45.0			
		1.65 to 1.95		40.0			55.0			
t _{B-M}	Break-Before-Make Time	3.6 to 4.3				5.0		ns	B ₀ or B ₁ = 1.5V, R _L = 50Ω, C _L = 35 pF	Figure 5
		2.7 to 3.6				5.0				
		2.3 to 2.7				5.0				
		1.65 to 1.95				5.0				
Q	Charge Injection	3.6 to 4.3		6.0				pC	C _L = 1.0 nF, V _{GEN} = 0V, R _{GEN} = 0Ω	Figure 7
		2.7 to 3.6		6.0						
		2.3 to 2.7		6.0						
		1.65 to 1.95								
OIRR	OFF-Isolation	3.6 to 4.3		-75.0				dB	f = 100kHz, R _L = 50Ω, C _L = 5 pF (Stray)	Figure 6
		2.7 to 3.6		-75.0						
		2.3 to 2.7		-75.0						
		1.65 to 1.95		-75.0						
Xtalk	Crosstalk	3.6 to 4.3		-75.0				dB	f = 100kHz, R _L = 50Ω, C _L = 5 pF (Stray)	Figure 6
		2.7 to 3.6		-75.0						
		2.3 to 2.7		-75.0						
		1.65 to 1.95		-70.0						
BW	-3db Bandwidth	1.65 to 4.3		80.0				MHz	R _L = 50Ω	Figure 9
THD	Total Harmonic Distortion	3.6 to 4.3						%	R _L = 32Ω, V _{IN} = 2V P.P, f = 20Hz to 20kHz	Figure 10
		2.7 to 3.6		0.02						
		2.3 to 2.7		0.036						
		1.65 to 1.95		0.01						

Capacitance

Symbol	Parameter	V _{CC} (V)	T _A = +25°C			T _A = 40°C to +85°C		Units	Conditions
			Min	Typ	Max	Min	Max		
C _{IN}	Control Pin Input Capacitance	0.0		1.5				pF	f = 1MHz (see Figure 8)
C _{OFF}	B Port OFF Capacitance	4.5		21.0				pF	f = 1MHz (see Figure 8)
C _{ON}	A Port ON Capacitance	4.5		90.0				pF	f = 1MHz (see Figure 8)

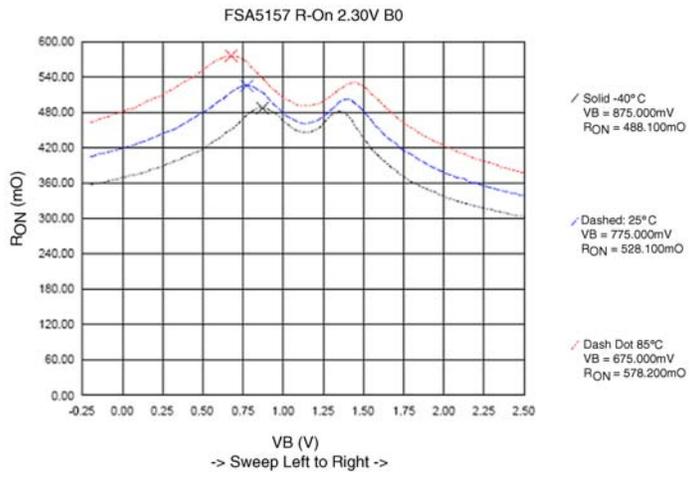


FIGURE 1. RON Switch On Resistance, $I_{ON} = 100mA$, $V_{CC} = 2.3V$

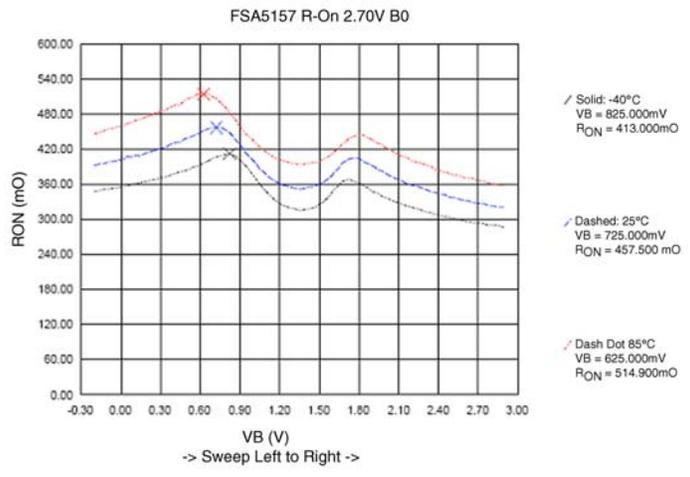


FIGURE 2. RON Switch On Resistance, $I_{ON} = 100mA$, $V_{CC} = 2.7V$

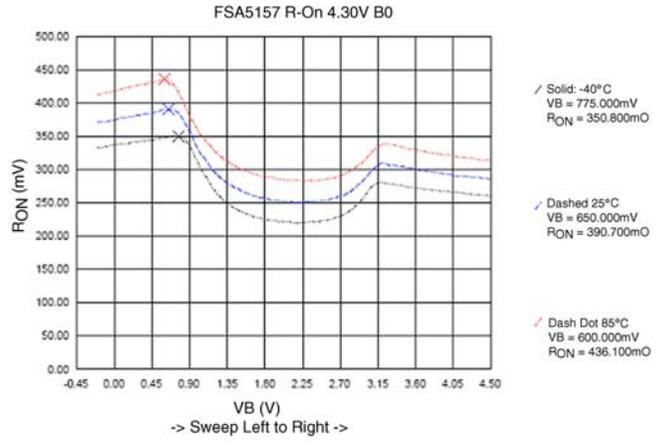
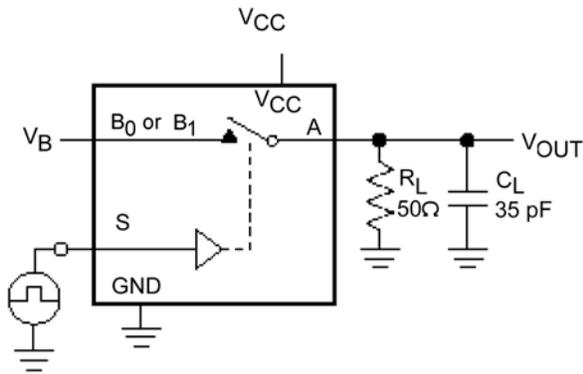
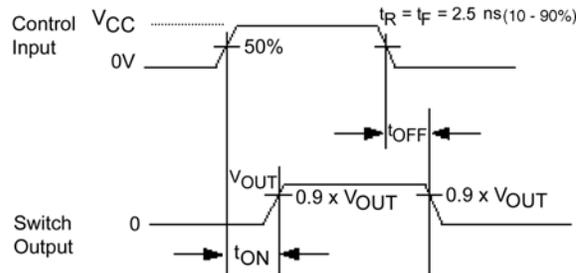


FIGURE 3. RON Switch On Resistance, $I_{ON} = 100mA$, $V_{CC} = 4.3V$

AC Loading and Waveforms

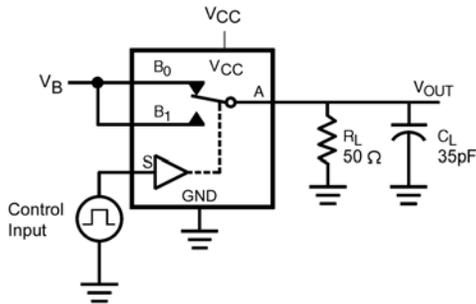


C_L includes Fixture and Stray Capacitance



Logic Input Waveforms Inverted for Switches that have the Opposite Logic Sense

FIGURE 4. Turn-On/Turn-Off Timing



C_L Includes Fixture and Stray Capacitance

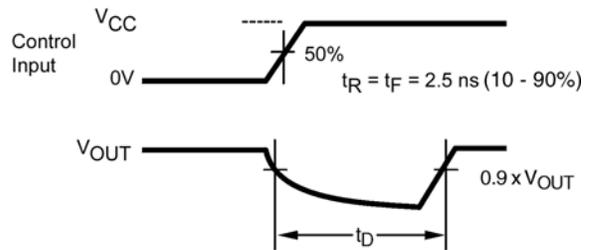
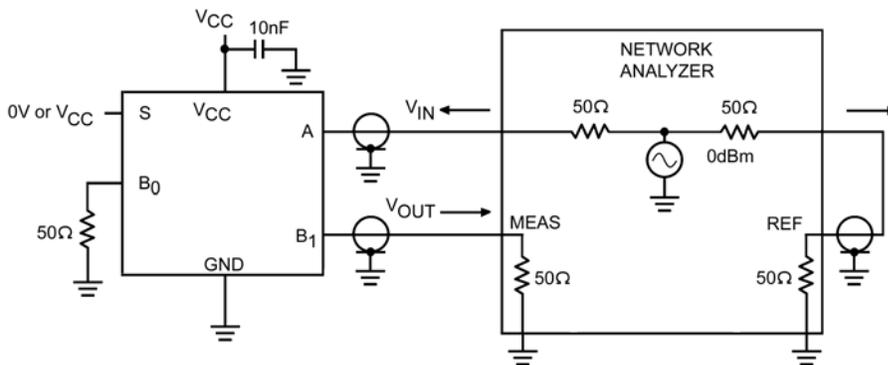


FIGURE 5. Break-Before-Make Timing



$$\text{OFF-ISOLATION} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

$$\text{ON-LOSS} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

$$\text{CROSSTALK} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

FIGURE 6. OFF Isolation and Crosstalk

AC Loading and Waveforms (Continued)

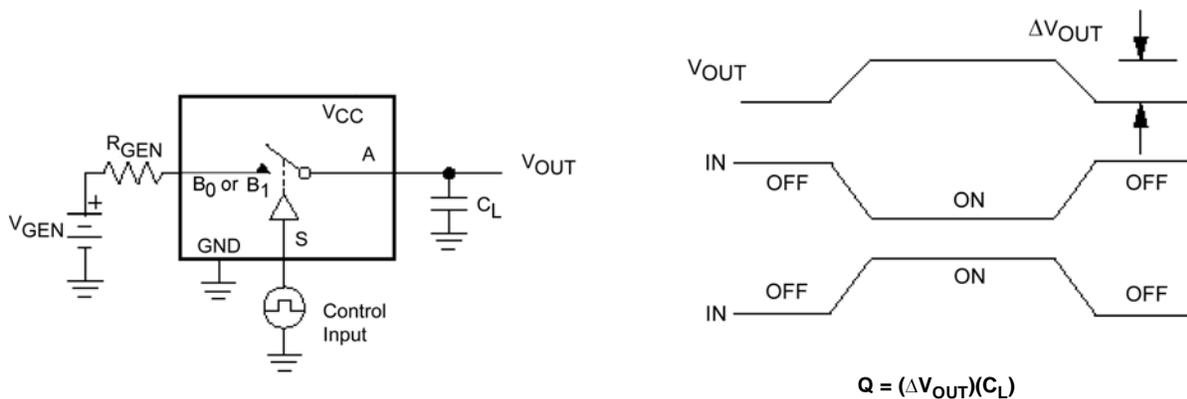


FIGURE 7. Charge Injection

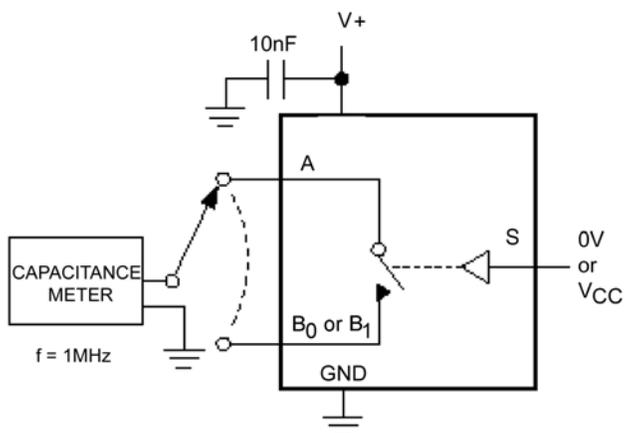


FIGURE 8. ON/OFF Capacitance Measurement Setup

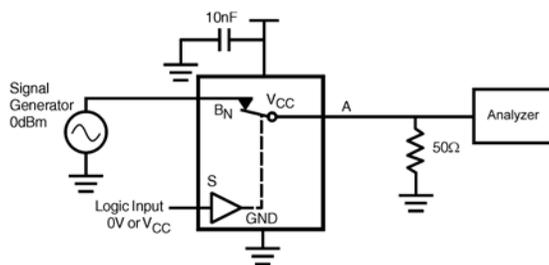


FIGURE 9. Bandwidth

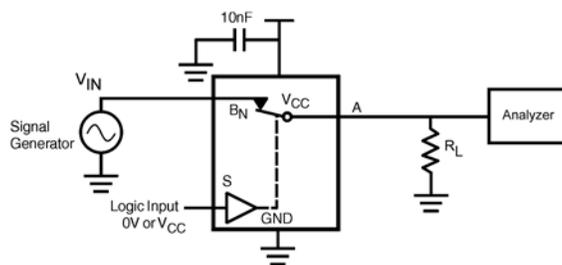
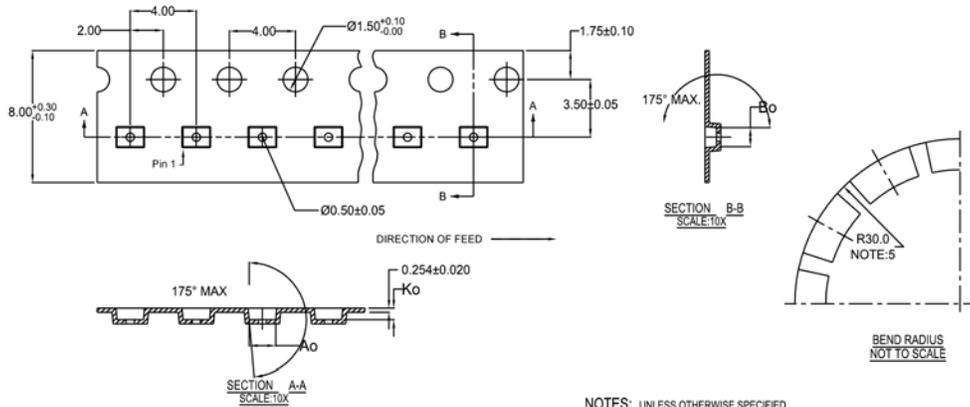


FIGURE 10. Harmonic Distortion

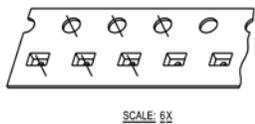
Tape and Reel Specification

Tape Format For Micropak 6

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



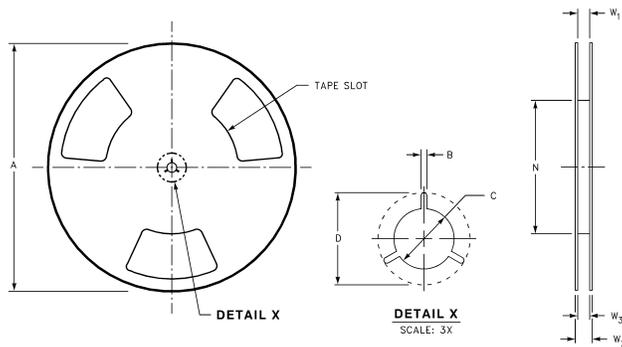
10	300056	2.30±0.05	1.78±0.05	0.68±0.05
8	300038	1.78±0.05	1.78±0.05	0.68±0.05
6	300033	1.60±0.05	1.15±0.05	0.70±0.05



NOTES: UNLESS OTHERWISE SPECIFIED

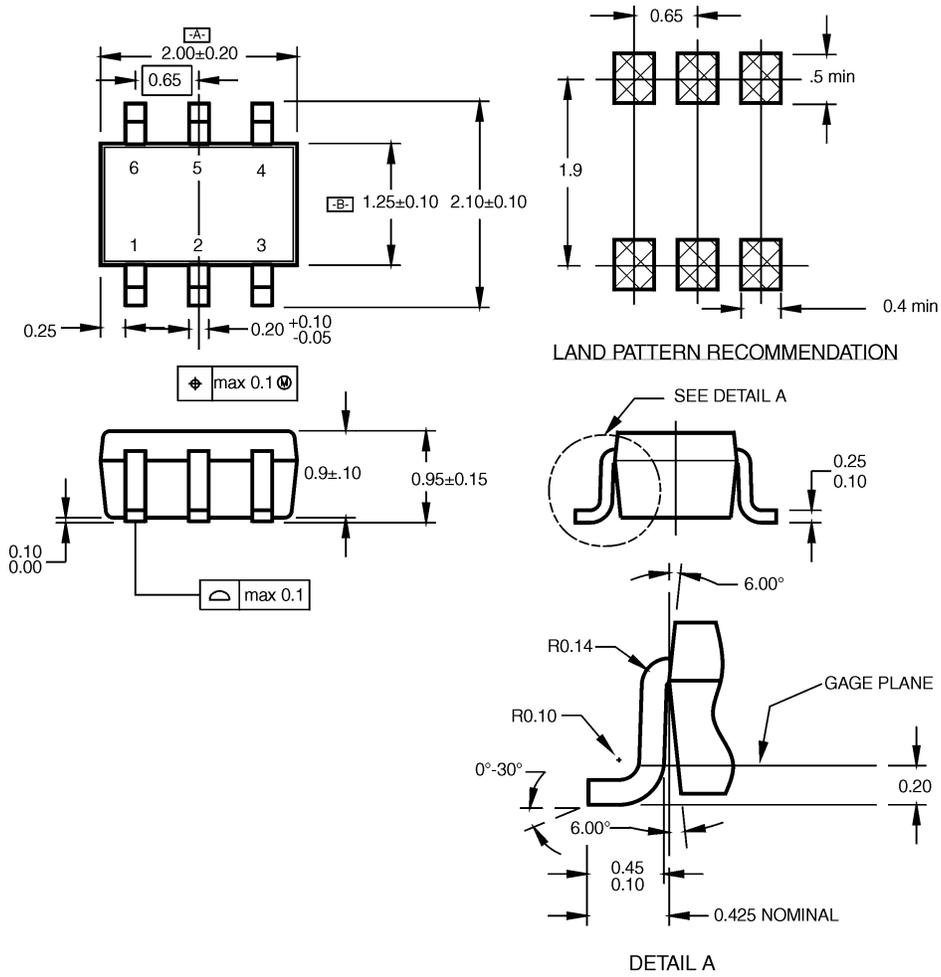
- ACCUMULATED 50 SPROCKETS, SPROCKET HOLE PITCH IS 200.00 ±0.30MM
- NO INDICATED CORNER RADIUS IS 0.127MM
- CAMBER NOT TO EXCEED 1MM IN 100MM
- SMALLEST ALLOWABLE BENDING RADIUS
- POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE

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



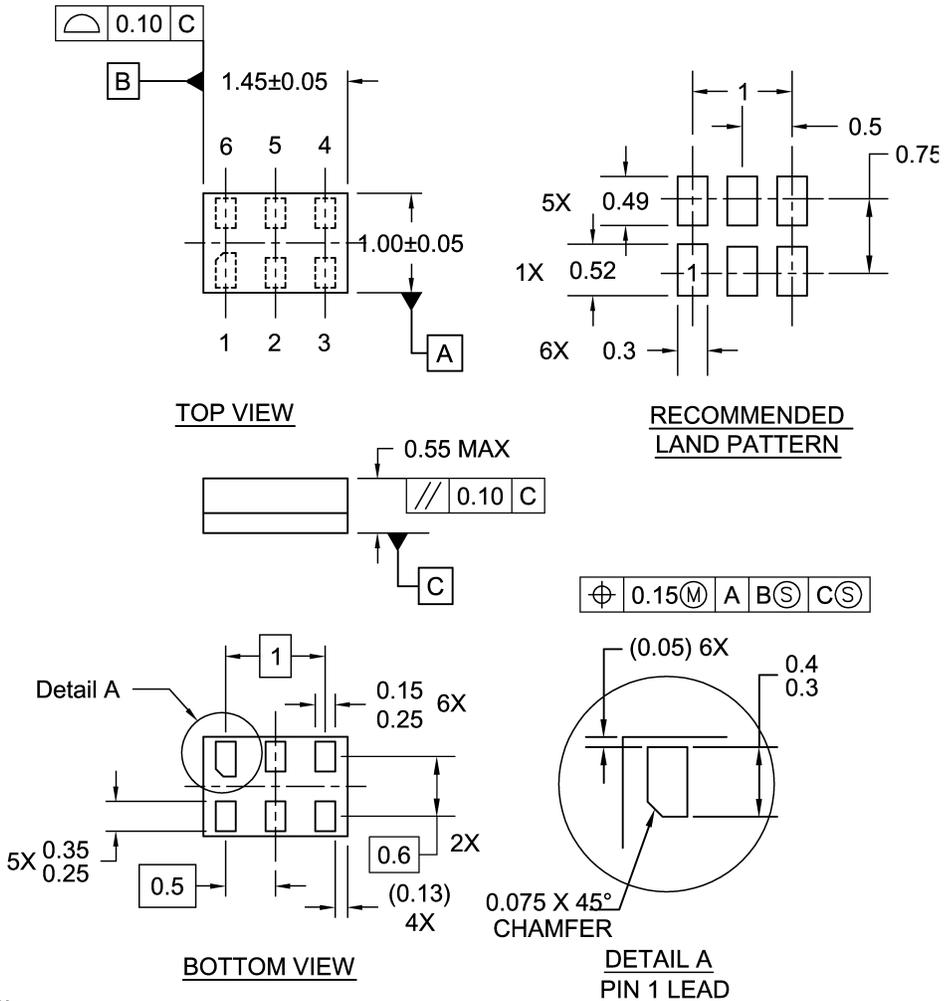
NOTES:

- A. CONFORMS TO EIAJ REGISTERED OUTLINE DRAWING SC88.
- B. DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH.
- C. DIMENSIONS ARE IN MILLIMETERS.

MAA06ARevC

**6-Lead SC70, EIAJ SC88, 1.25mm Wide
Package Number MAA06A**

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**

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provided in the labeling, can be reasonably expected to result in significant injury to the user.

2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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