

FSA5157 **0.4Ω Low Voltage SPDT Analog Switch**

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 0.4Ω impedance, sub 1μA current consumption, and 1.65V to 4.3V operating voltage range makes this product ideal for battery powered 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

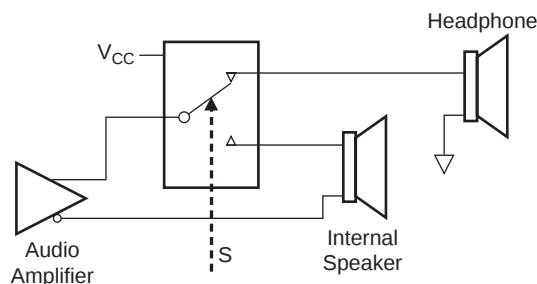
- Cellular phone
- PDA
- Portable Media Player

Ordering Information

Order Number	Package Number	Product Code Top Mark	Package Description	Supplied As
FSA5157P6X	MAA06A	C57	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

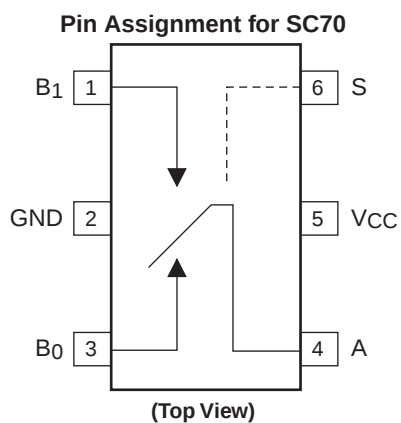
Pb-Free package per JEDEC J-STD-020B.

Applications Diagram

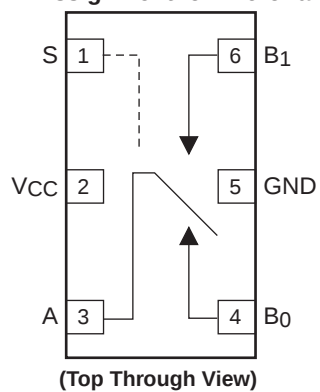


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Analog Symbols



Pin Assignment for MicroPak



Truth Table/s

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

(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.)

Symbol	Parameter	Rating
V_{CC}	Supply Voltage	–0.5V to +4.6V
V_S	Switch Voltage ¹	–0.5V to $V_{CC} + 0.3V$
V_{IN}	Input Voltage ¹	–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
	Power Dissipation (P_D) SC70 6L Package MicroPak 6L Package	180 mW 180 mW
T_{STG}	Storage Temperature Range	–65°C to +150°C
T_J	Maximum Junction Temperature	+150°C
T_L	Lead Temperature Soldering, 10 seconds	+260°C
	ESD, Human Body Model	8000V

Recommended Operating Conditions

Symbol	Parameter	Rating
V_{CC}	Supply Voltage	1.65V to 4.3V
V_{IN}	Control Input Voltage ²	0V to V_{CC}
V_{IN}	Switch Input Voltage	0V to V_{CC}
T_A	Operating Temperature	–40°C to +85°C

Notes:

1. The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.
2. 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	Conditions	V _{CC} (V)	T _A =					Units
				+25°C			-40°C to +85°C		
				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	V _{IN} = 0V to V _{CC}	1.65 to 4.3				-0.5	0.5	μA
I _{NO(OFF)} , I _{NC(OFF)}	OFF-Leakage Current of Port B ₀ and B ₁	A = 0.3V, V _{CC} – 0.3V, B ₀ or B ₁ = 0.3V, V _{CC} – 0.3V or Floating	1.95 to 4.3	-10.0		10.0	-50.0	50.0	nA
I _{A(ON)}	ON Leakage Current of Port A	A = 0.3V, V _{CC} – 0.3V, B ₀ or B ₁ = 0.3V, V _{CC} – 0.3V or Floating	1.95 to 4.3	-20.0		20.0	-100	100	nA
R _{ON}	Switch On Resistance ³	I _{OUT} = 100 mA, B ₀ or B ₁ = 0V, 0.7V, 3.6V, 4.3V	4.3		0.36			0.6	Ω
		I _{OUT} = 100 mA, B ₀ or B ₁ = 0V, 0.7V, 2.0V, 2.7V	2.7		0.4			0.7	
		I _{OUT} = 100 mA, B ₀ or B ₁ = 0V, 0.7V, 2.0V, 2.3V	2.3		0.55			0.8	
		I _{OUT} = 100 mA, B ₀ or B ₁ = 0.7V	1.65		1.5	2.5		3.0	
ΔR _{ON}	On Resistance Matching Between Channels ⁴	I _{OUT} = 100 mA, B ₀ or B ₁ = 0.7V	4.3		0.04			0.75	Ω
			2.7		0.06			0.13	
			2.3		0.12			0.2	
			1.65		1.0				
R _{FLAT(ON)}	On Resistance Flatness ⁵	I _{OUT} = 100 mA, B ₀ or B ₁ = 0V to V _{CC}	4.3					0.25	Ω
			2.7					0.25	
			2.3					0.3	
			1.65		0.3				
I _{CC}	Quiescent Supply Current	V _{IN} = 0V or V _{CC} , I _{OUT} = 0	4.3	-100.0	30.0	100.0	-500	500	nA
I _{CCT}	Increase in I _{CC} per Control Input	V _{IN} = 1.8V	4.3		7.0	12.0		15.0	μA
		V _{IN} = 2.6V	4.3		3.0	6.0		7.0	

Notes:

- On Resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.
- ΔR_{ON} = R_{ONmax} – R_{ONmin} measured at identical V_{CC}, temperature, and voltage.
- 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 values are @ 25°C unless otherwise specified)

Symbol	Parameter	Conditions	V _{CC} (V)	T _A =					Units	Figure
				+25°C			–40°C to +85°C			
				Min	Typ	Max	Min	Max		
t _{ON}	Turn ON Time	B ₀ or B ₁ = 1.5V, R _L = 50Ω, C _L = 35 pF	3.6 to 4.3			55.0		60.0	ns	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	B ₀ or B ₁ = 1.5V, R _L = 50Ω, C _L = 35 pF	3.6 to 4.3			30.0		35.0	ns	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	B ₀ or B ₁ = 1.5V, R _L = 50Ω, C _L = 35 pF	3.6 to 4.3				5.0		ns	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	C _L = 1.0 nF, V _{GEN} = 0V, R _{GEN} = 0Ω	3.6 to 4.3		6.0				pC	Figure 8
			2.7 to 3.6		6.0					
			2.3 to 2.7		6.0					
			1.65 to 1.95							
OIRR	OFF-Isolation	f = 100kHz, R _L = 50Ω, C _L = 5 pF (Stray)	3.6 to 4.3		–75.0				dB	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	f = 100kHz, R _L = 50Ω, C _L = 5 pF (Stray)	3.6 to 4.3		–75.0				dB	Figure 7
			2.7 to 3.6		–75.0					
			2.3 to 2.7		–75.0					
			1.65 to 1.95		–70.0					
BW	–3db Bandwidth	R _L = 50Ω	1.65 to 4.3		80.0				MHz	Figure 10
THD	Total Harmonic Distortion		3.6 to 4.3						%	Figure 11
		R _L = 32Ω, V _{IN} = 2V P.P, f = 20Hz to 20kHz	2.7 to 3.6		0.02					
		R _L = 32Ω, V _{IN} = 1.5V P.P, f = 20Hz to 20kHz	2.3 to 2.7		0.036					
		R _L = 32Ω, V _{IN} = 1.2V P.P, f = 20Hz to 20kHz	1.65 to 1.95		0.01					

Capacitance

Symbol	Parameter	Conditions	V _{CC} (V)	T _A =					Units
				+25°C			40°C to +85°C		
				Min	Typ	Max	Min	Max	
C _{IN}	Control Pin Input Capacitance	f = 1MHz (see Figure 9)	0.0		1.5				pF
C _{OFF}	B Port OFF Capacitance	f = 1MHz (see Figure 9)	4.5		21.0				pF
C _{ON}	A Port ON Capacitance	f = 1MHz (see Figure 9)	4.5		90.0				pF

Typical Characteristics

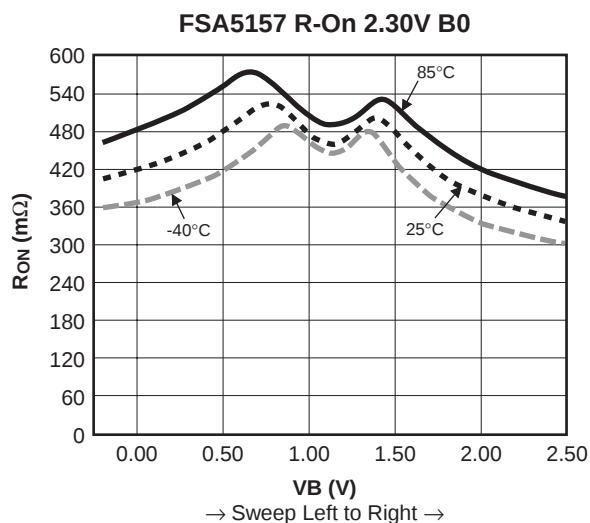


Figure 1. R_{ON} Switch On Resistance,
 $I_{ON} = 100\text{mA}$, $V_{CC} = 2.3\text{V}$

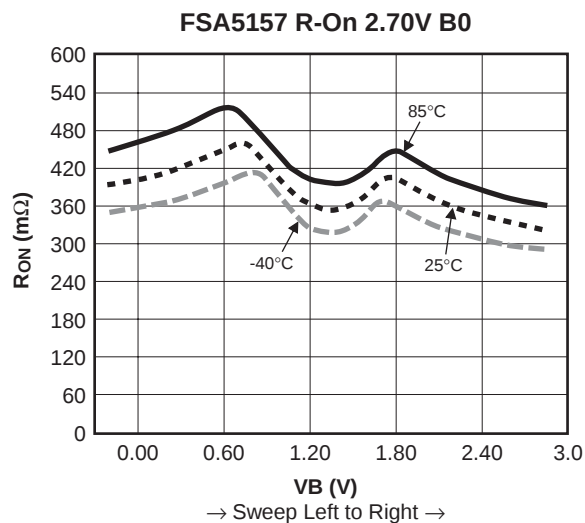


Figure 2. R_{ON} Switch On Resistance,
 $I_{ON} = 100\text{mA}$, $V_{CC} = 2.7\text{V}$

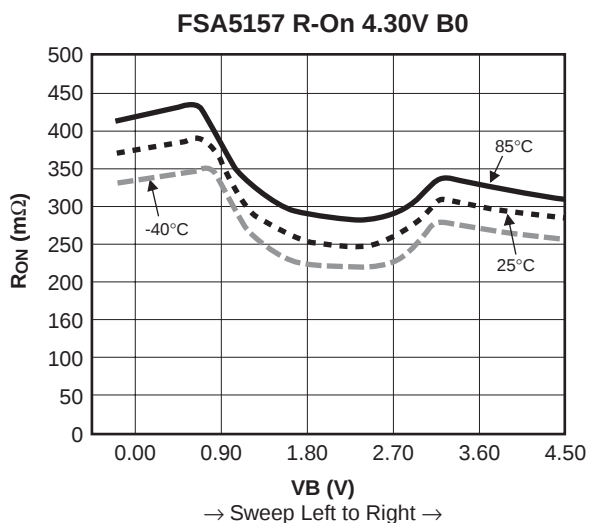
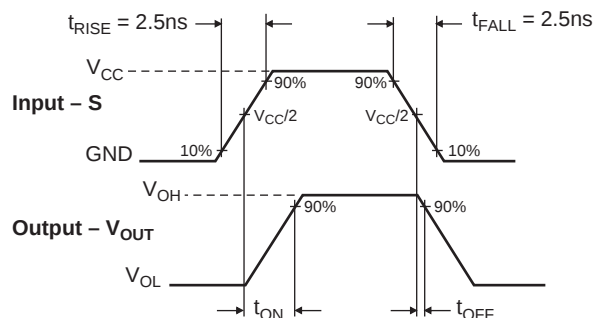
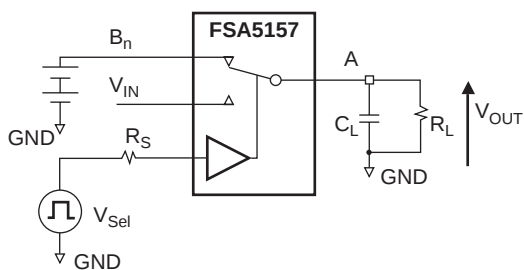


Figure 3. R_{ON} Switch On Resistance,
 $I_{ON} = 100\text{mA}$, $V_{CC} = 4.3\text{V}$

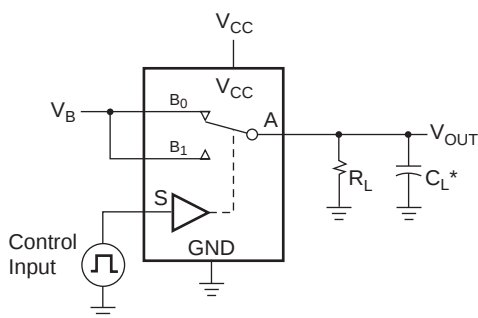
AC Loading and Waveforms



Notes:

1. R_L , R_S , and C_L are functions of application environment (See AC Electrical table for specific values).
2. C_L includes test fixture and stray capacitance.

Figure 4. Turn-On/Turn-Off Timing



* C_L includes fixture and stray capacitance

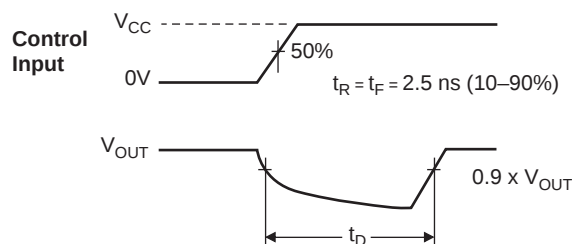
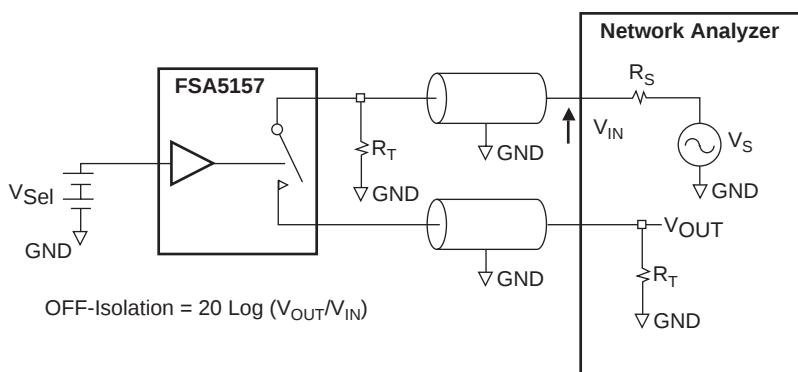


Figure 5. Break-Before-Make Timing



$$\text{OFF-Isolation} = 20 \log (V_{OUT}/V_{IN})$$

Figure 6. OFF Isolation

Generator

V_S , R_S , GND

V_{IN} nB_n

FSA5157

C_L^* , GND , V_{OUT}

nS_n , V_{Sel} , GND

* C_L includes fixture and stray capacitance

Input - V_{Sel} (Off, On, Off)

V_{CC} , $0V$

V_{OUT} , ΔV_{OUT}

$Q = \Delta V_{OUT} \times C_L$

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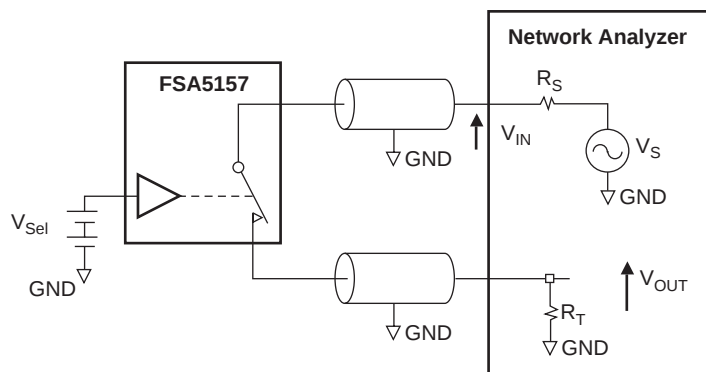


Figure 10. Bandwidth

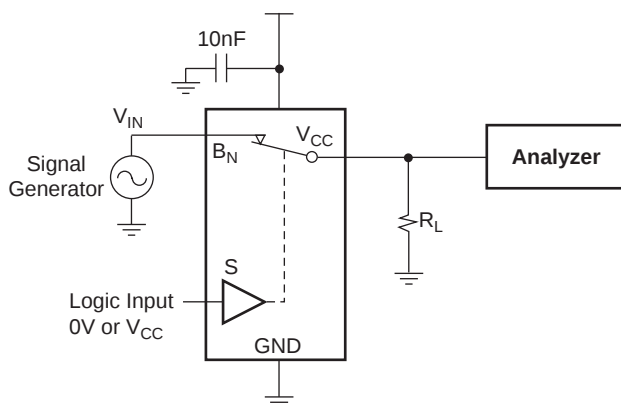
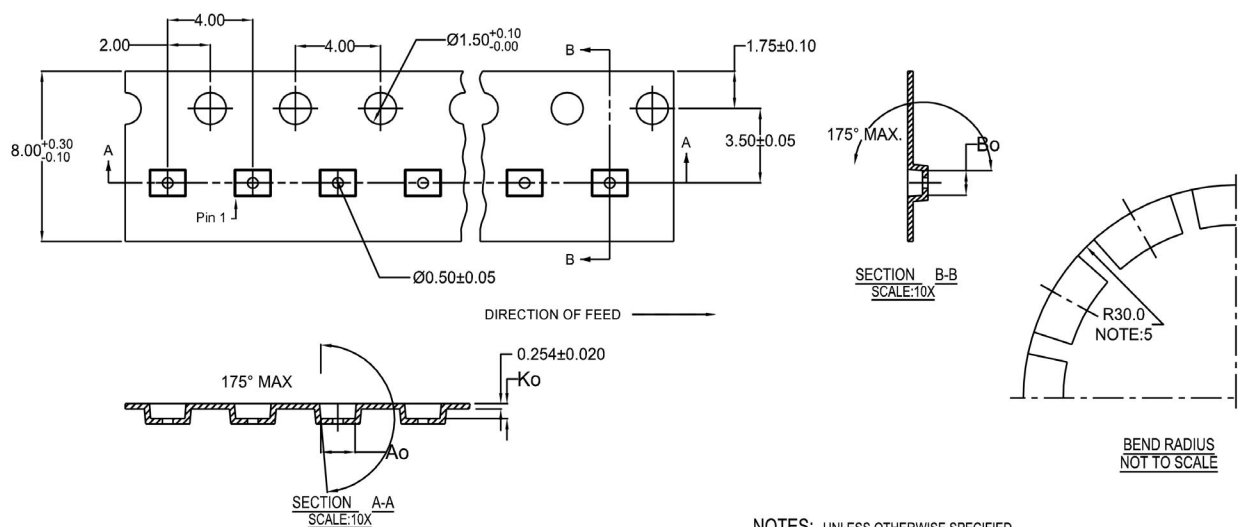


Figure 11. Harmonic Distortion

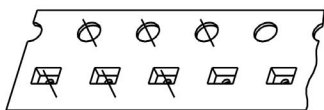
Tape Specification

Tape Format For Micropak 6

Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
	Leader (Start End)	125 (typ)	Empty	Sealed
L6X	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

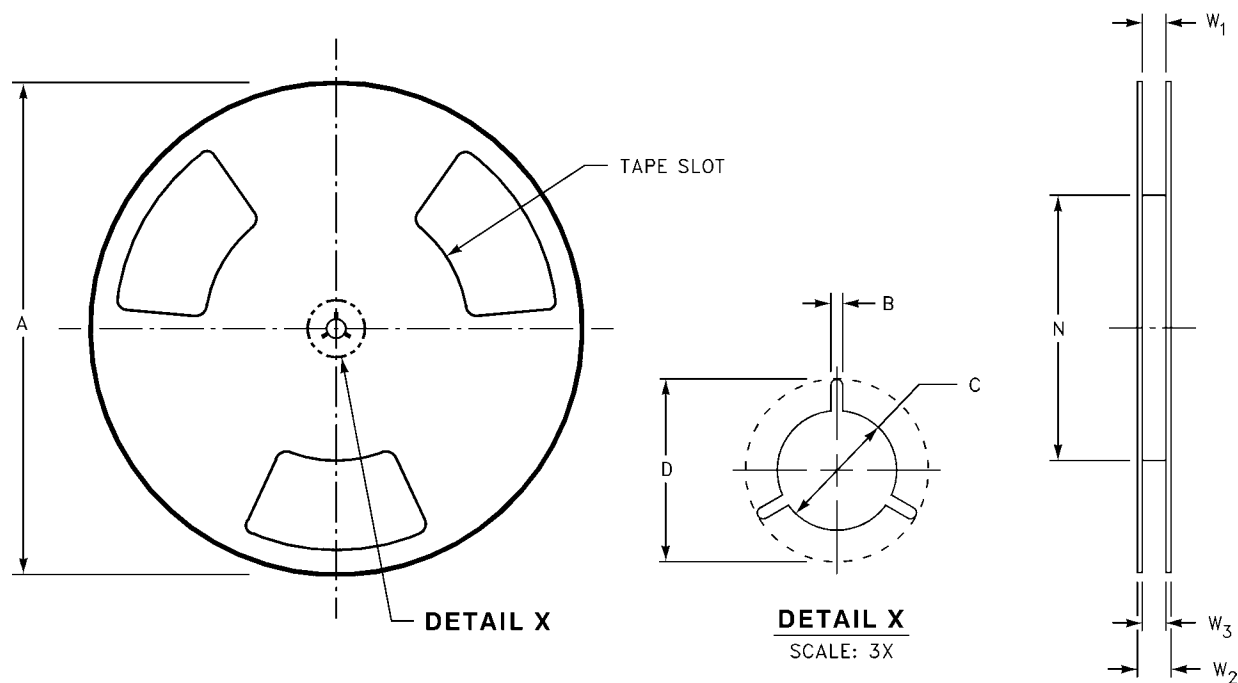


SCALE: 6X

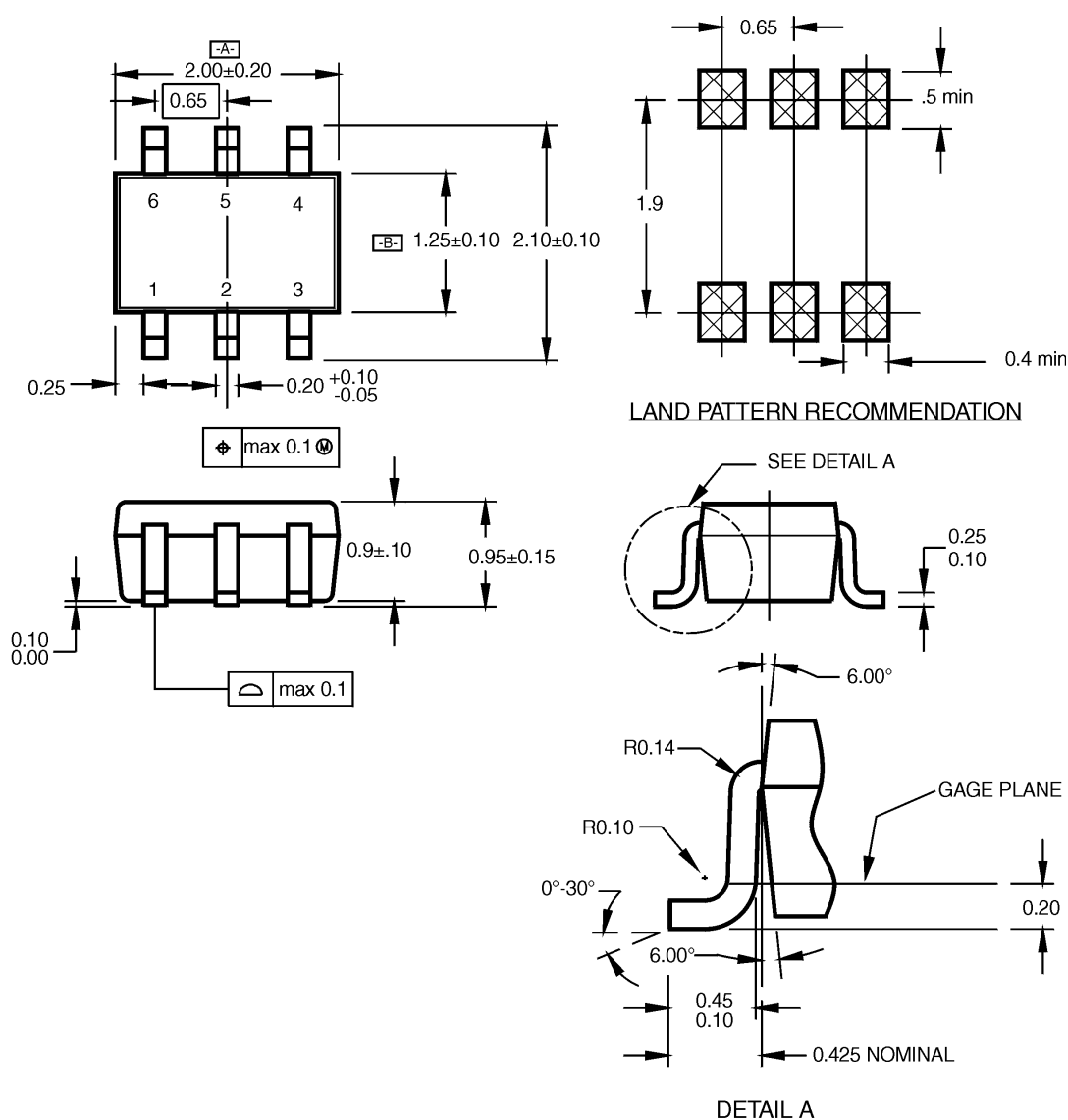
NOTES: UNLESS OTHERWISE SPECIFIED

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

Reel Dimensions for Micropack 6 inches (millimeters)



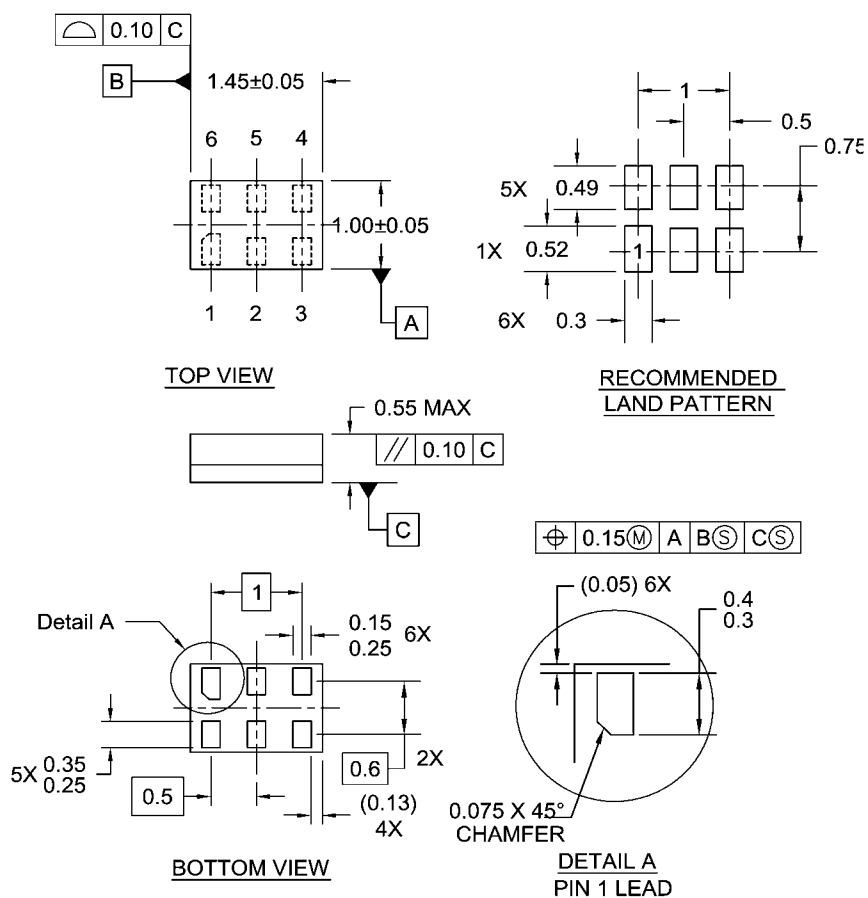
Tape Size	A	B	C	D	N	W1	W2	W3
8 mm	7.0 (177.8)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.331 +0.059 / -0.000 (8.40 +1.50 / -0.00)	0.567 (14.40)	W1 + 0.078 / -0.039 (W1 + 2.00 / -1.00)

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

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



MAC06ARevB

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

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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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