FAIRCHILD SEMICONDUCTOR™

August 2003
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FSA4157 • FSA4157A
Low Voltage 1 Ω SPDT Analog Switch

General Description

FSA4157 and FSA4157A are high performance Single Pole/Double Throw (SPDT) analog switches. Both devices feature ultra low R_{ON} of 1.15 Ω maximum at 4.5V V_{CC} and will operate over the wide V_{CC} range of 1.65V to 5.5V for FSA4157, and 2.7V to 5.5V for FSA4157A. The device is fabricated with sub-micron CMOS technology to achieve fast switching speeds and is designed for break-before-make operation. The select input is TTL level compatible.

The FSA4157A features very low quiescent current even when the control voltage is lower than the V_{CC} supply. This feature services the mobile handset applications very well allowing for the direct interface with baseband processor general purpose I/Os.

Features

- FSA4157A features lower I_{CC} when the S input is lower than V_{CC}
- Maximum 1.15 Ω On Resistance (R_{ON}) at 4.5V V_{CC}
- 0.3 Ω max R_{ON} flatness at 4.5V V_{CC}
- Space saving 6-lead Pb-Free MicroPak™ and SC70 6-lead surface mount packages
- Broad V_{CC} operating range:
  - FSA4157: 1.65V to 5.5V
  - FSA4157A: 2.7V to 5.5V
- Fast turn-on and turn-off time
- Break-before-make enable circuitry
- Over-voltage tolerant TTL compatible control circuitry

Ordering Code:

Order Number	Package Number	Product Code Top Mark	Package Description	Supplied As
FSA4157P6	MAA06A	A57	6-Lead SC70, EIAJ SC88, 1.25mm Wide	250 Units on Tape and Reel
FSA4157P6X	MAA06A	A57	6-Lead SC70, EIAJ SC88, 1.25mm Wide	3k Units on Tape and Reel
FSA4157P6X_NL (Note 1)	MAA06A	A57	Pb-Free 6-Lead SC70, EIAJ SC88, 1.25mm Wide	3k Units on Tape and Reel
FSA4157L6X	MAC06A	EG	Pb-Free 6-Lead MicroPak, 1.0mm Wide	5k Units on Tape and Reel
FSA4157AP6	MAA06A	B57	6-Lead SC70, EIAJ SC88, 1.25mm Wide	250 Units on Tape and Reel
FSA4157AP6X	MAA06A	B57	6-Lead SC70, EIAJ SC88, 1.25mm Wide	3k Units on Tape and Reel
FSA4157AP6X_NL (Note 1)	MAA06A	B57	Pb-Free 6-Lead SC70, EIAJ SC88, 1.25mm Wide	3k Units on Tape and Reel
FSA4157AL6X	MAC06A	EU	Pb-Free 6-Lead MicroPak, 1.0mm Wide	5k Units on Tape and Reel

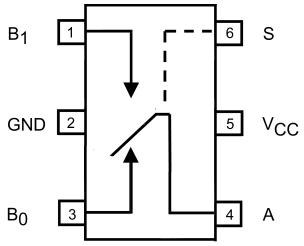
Pb-Free package per JEDEC J-STD-020B.

Note 1: "_NL" indicates lead-free package (per JEDEC J-STD-020B). Device available in Tape and Reel only.

MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

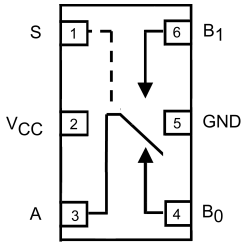
Analog Symbols

Pin Assignment for SC70



(Top View)

Pin Assignment for MicroPak



(Top Through View)

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 Name	Description
A, B_0, B_1	Data Ports
S	Control Input

Absolute Maximum Ratings (Note 2)

Supply Voltage (V_{CC})	−0.5V to +6.0V
DC Switch Voltage (Note 3)	−0.5V to V_{CC} +0.5V
DC Input Voltage (V_{IN}) (Note 3)	−0.5V to +6.0V
DC Input Diode Current	−50 mA
Switch Current	200 mA
Peak Switch Current	
(Pulse at 1 mS duration,	
<10% Duty Cycle)	400 mA
Power Dissipation (P_D) @ 85°C	
SC70 6L Package	180 mW
MicroPak 6L Package	180 mW
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)	
FSA4157A	7500V

Recommended Operating Conditions (Note 4)

Supply Voltage (V_{CC})	
FSA4157	1.65V to 5.5V
FSA4157A	2.7V to 5.5V
Control Input Voltage	0V to V_{CC}
Switch Input Voltage	0V to V_{CC}
Operating Temperature	−40°C to 85°C
Thermal Resistance θ_{JA} in still air	
SC70 6L Package	350°C/W
MicroPak 6L Package	330°C/W (estimated)

Note 2: 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 rating. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Note 3: The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.

Note 4: Control input must be held HIGH or LOW and it must not float.

DC Electrical Characteristics (all typical values are at 25°C unless otherwise specified)

Symbol	Parameter	V_{CC} (V)	T_A = +25 °C			T_A = −40°C to +85°C		Units	Conditions
			Min	Typ	Max	Min	Max		
V_{IH}	Input Voltage High	2.7 to 3.6				2.0		V	
		4.5 to 5.5				2.4			
V_{IL}	Input Voltage Low	2.7 to 3.6					0.4	V	(FSA4157A Only)
		2.7 to 3.6					0.6		
		4.5 to 5.5					0.8		
I_{IN}	Control Input Leakage	2.7 to 3.6				−1.0	1.0	µA	V_{IN} = 0V to V_{CC}
		4.5 to 5.5				−1.0	1.0		
$I_{NO(OFF)}$, $I_{NC(OFF)}$	OFF Leakage Current of Port B_0 and B_1	5.5	−2.0		2.0	−20.0	20.0	nA	A = 1V, 4.5V B_0 or B_1 = 4.5V, 1V
$I_{A(ON)}$	ON Leakage Current of Port A	5.5	−4.0		4.0	−40.0	40.0	nA	A = 1V, 4.5V B_0 or B_1 = 1V, 4.5V or Floating
R_{ON}	Switch ON Resistance (Note 5)	2.7		2.6	4.0		4.3	Ω	I_{OUT} = 100mA, B_0 or B_1 = 1.5V
		4.5		0.95	1.15		1.3		I_{OUT} = 100mA, B_0 or B_1 = 3.5V
ΔR_{ON}	On Resistance Matching Between Channels (Note 6)	4.5		0.06	0.12		0.15	Ω	I_{OUT} = 100mA, B_0 or B_1 = 1.5V
$R_{FLAT(ON)}$	On Resistance Flatness (Note 7)	2.7		1.4				Ω	I_{OUT} = 100mA, B_0 or B_1 = 0V, 0.75V,1.5V
		4.5		0.2	0.3		0.4		I_{OUT} = 100mA, B_0 or B_1 = 0V, 1V, 2V
I_{CC}	Quiescent Supply Current	3.6		0.1	0.5		1.0	µA	V_{IN} = 0V or V_{CC}, I_{OUT} = 0V
		5.5		0.1	0.5		1.0		V_{IN} = 0V or V_{CC}, I_{OUT} = 0V
ΔI_{CC}	Increase in I_{CC} per Input	4.3		0.2			10.0	µA	One Input at 2.7V, others at V_{CC} or GND (FSA4157A only)

Note 5: 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 voltage on the two (A or B Ports).

Note 6: $\Delta R_{ON} = R_{ON\,max} - R_{ON\,min}$ measured at identical V_{CC}, temperature and voltage.

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 (all typical value are at 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	2.7 to 3.6			60.0		65.0	ns	B_0 or B_1 = 1.5V, R_L = 50Ω, C_L = 35 pF (FSA4157A only)	Figure 3
		2.7 to 3.6			50.0		60.0		B_0 or B_1 = 1.5V, R_L = 50Ω, C_L = 35 pF	
		4.5 to 5.5			35.0		40.0		B_0 or B_1 = 3V, R_L = 50Ω, C_L = 35 pF	
t_{OFF}	Turn OFF Time	2.7 to 3.6			20.0		30.0	ns	B_0 or B_1 = 1.5V, R_L = 50Ω, C_L = 35 pF	Figure 3
		4.5 to 5.5			15.0		20.0		B_0 or B_1 = 3V, R_L = 50Ω, C_L = 35 pF	
t_{B-M}	Break Before Make Time	2.7 to 3.6						ns		Figure 4
		4.5 to 5.5		20.0						
		4.5 to 5.5		25.0					(FSA4157A only)	
Q	Charge Injection	2.7 to 3.6		10.0				pC	C_L = 1.0nF, V_{GE} = 0V, R_{GEN} = 0Ω	Figure 6
		4.5 to 5.5		20.0						
OIRR	OFF- Isolation	2.7 to 3.6		−70.0				dB	f = 1MHz, R_L = 50Ω	Figure 5
		4.5 to 5.5		−70.0						
Xtalk	Crosstalk	2.7 to 3.6		−70.0				dB	f = 1MHz, R_L = 50Ω	Figure 5
		4.5 to 5.5		−70.0						
BW	−3db Bandwidth	2.7 to 3.6		350				MHz	R_L = 50Ω	Figure 8
		4.5 to 5.5		350						
THD	Total Harmonic Distortion	2.7 to 3.6		0.002				%	R_L = 600Ω, V_{IN} = 0.5V P.P, f = 20 Hz to 20 k Hz	Figure 9
		4.5 to 5.5		0.002						

Capacitance

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			
C_{IN}	Control Pin Input Capacitance	0		3.5				pF	f = 1MHz	Figure 7
C_{OFF}	B Port OFF Capacitance	4.5		12.0				pF	f = 1MHz	Figure 7
C_{ON}	On Capacitance	4.5		40.0				pF	f = 1MHz	Figure 7

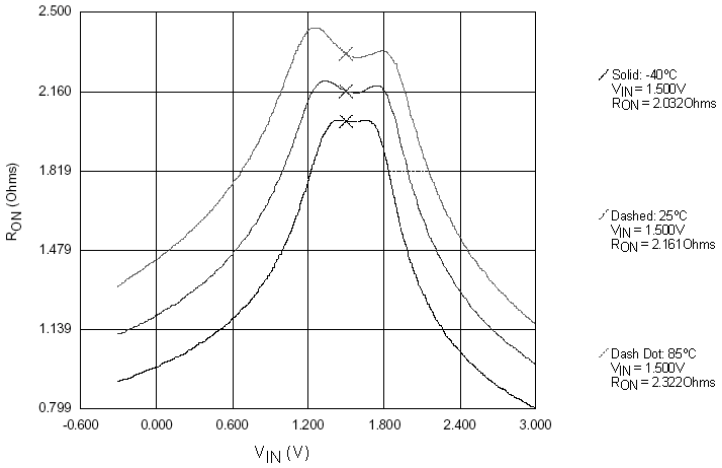


FIGURE 1. R_{ON} Switch On Resistance, I_{ON} = 100mA, V_{CC} = 2.7V

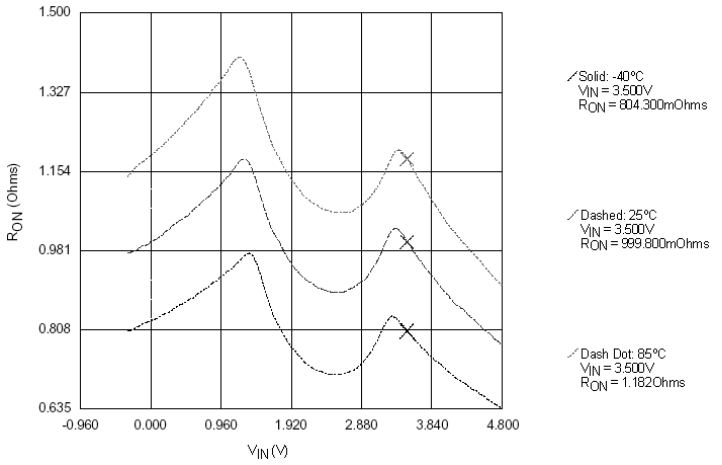
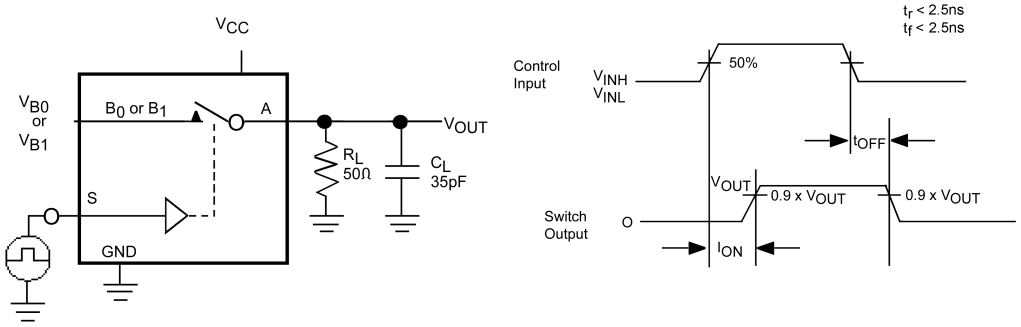


FIGURE 2. R_{ON} Switch On Resistance, I_{ON} = 100mA, V_{CC} = 4.5V

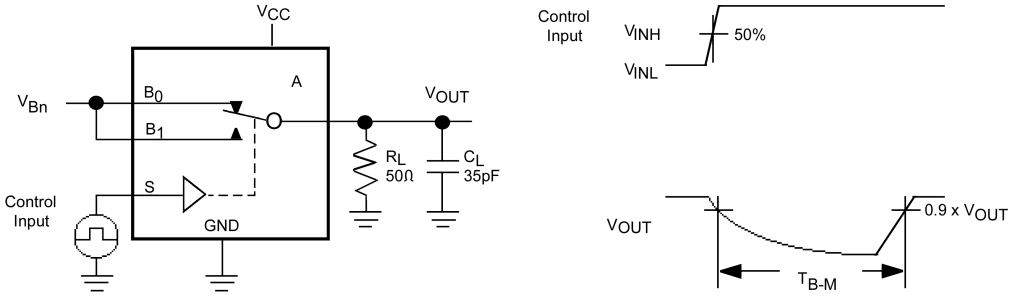
AC Loading and Waveforms



C_L Includes Fixture and Stray Capacitance

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

FIGURE 3. Turn ON/OFF Timing



C_L Includes Fixture and Stray Capacitance

FIGURE 4. Break Before Make Timing

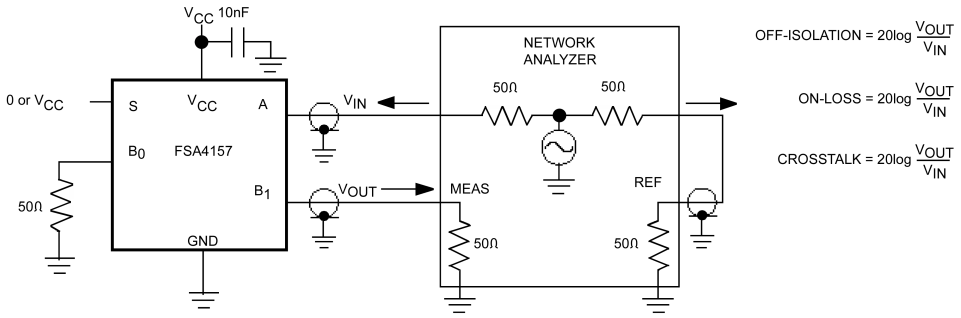


FIGURE 5. OFF Isolation and Crosstalk

AC Loading and Waveforms (Continued)

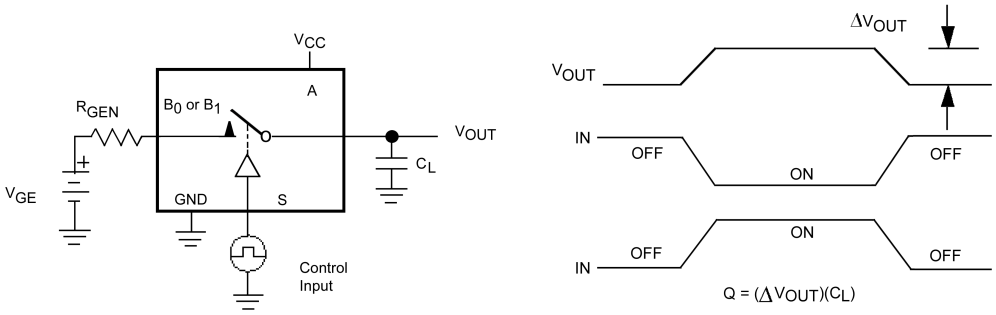


FIGURE 6. Charge Injection

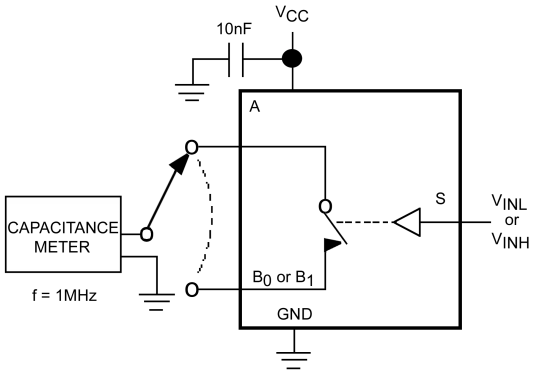


FIGURE 7. ON/OFF Capacitance Measurement Setup

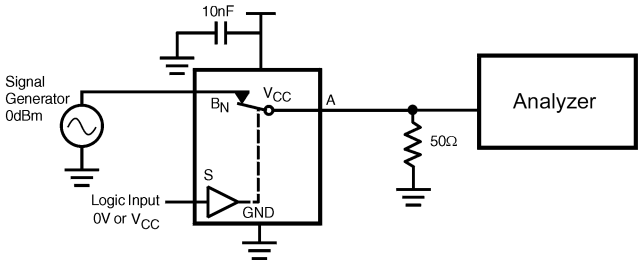


FIGURE 8. Bandwidth

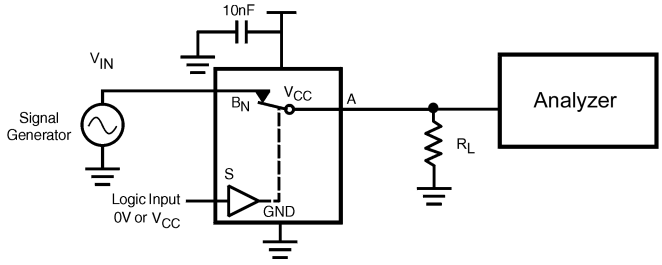
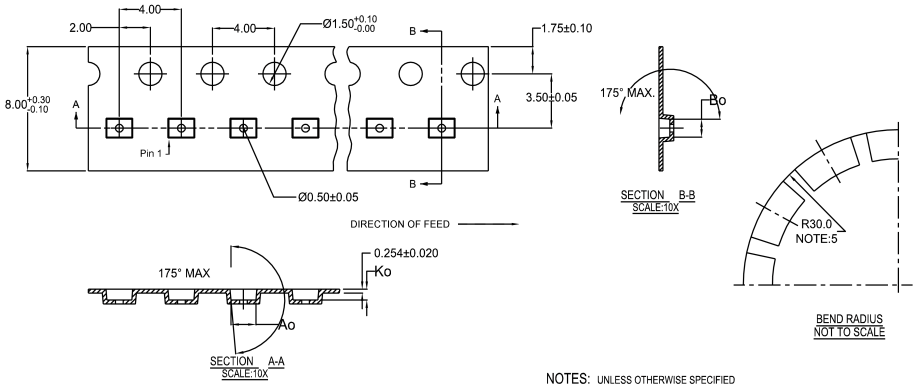


FIGURE 9. Harmonic Distortion

Tape and Reel Specification

Tape Format For Micropak 6

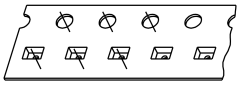
Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
L6X	Leader (Start End)	125 (typ)	Empty	Sealed
	Carrier	5000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed



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

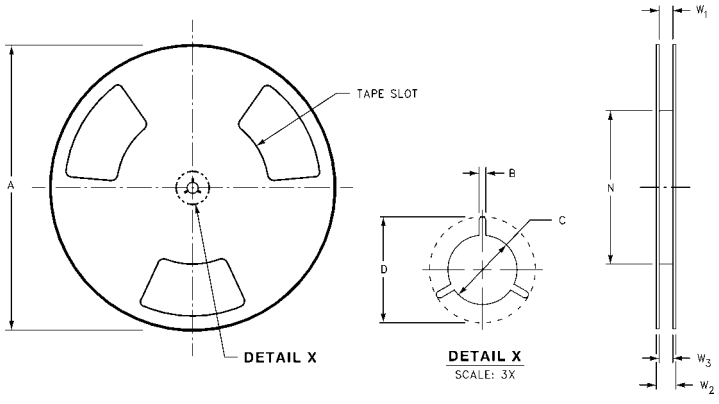
NOTES: UNLESS OTHERWISE SPECIFIED

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



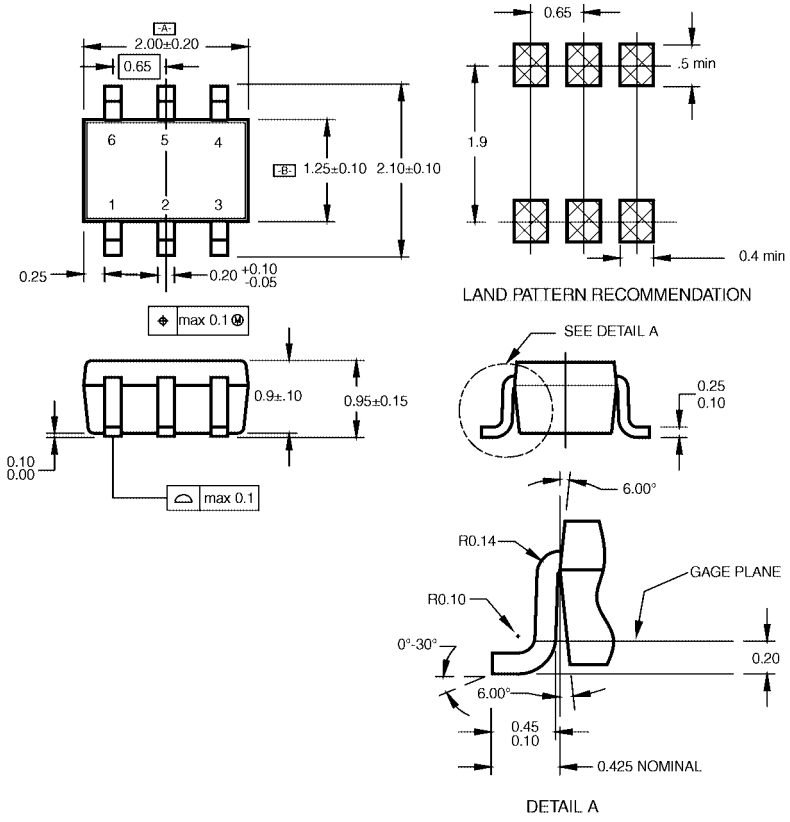
SCALE: 6X

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



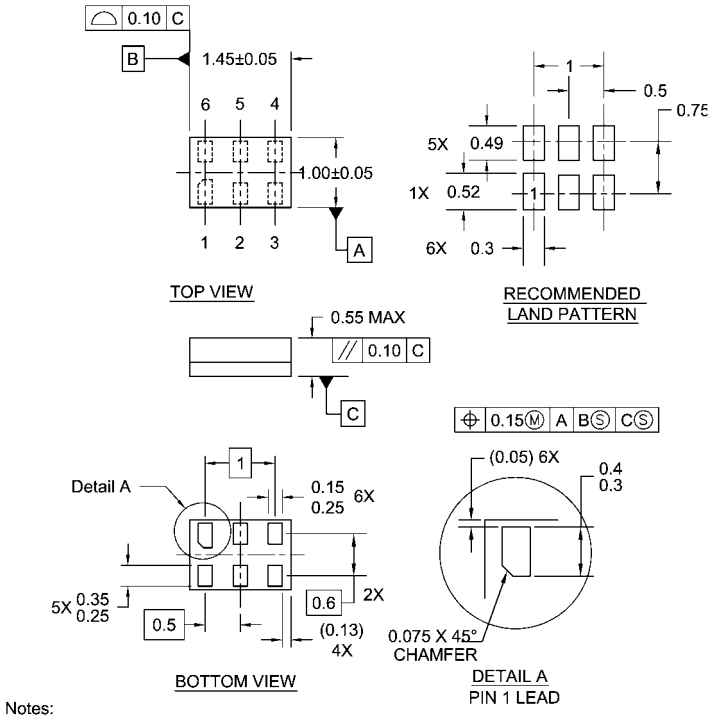
NOTES:

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

Technology Description

The Fairchild Switch family derives from and embodies Fairchild's proven switch technology used for several years in its 74LVX3L384 (FST3384) bus switch product.