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# FSA5157

## 0.4Ω Low-Voltage SPDT Analog Switch

### 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
- 1.0 x 1.45mm 6-Lead 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


### 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-μA 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 break-before-make 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 is designed to minimize current consumption under this condition. The  $I_{CCT}$  is specified for <12μA under a worst-case condition of  $V_{CC} = 4.3V$  and  $V_{IN} = 1.8V$ .

### Ordering Information

Order Number	Top Mark	Package Description	Packing Method
FSA5157P6X	C57	6-Lead SC70, EIAJ SC88, 1.25mm Wide	3000 Units on Tape and Reel
FSA5157L6X	FT	6-Lead MicroPak, 1.0mm Wide	5000 Units on Tape and Reel

 All packages are lead free per JEDEC: J-STD-020B standard.

### Application Diagram

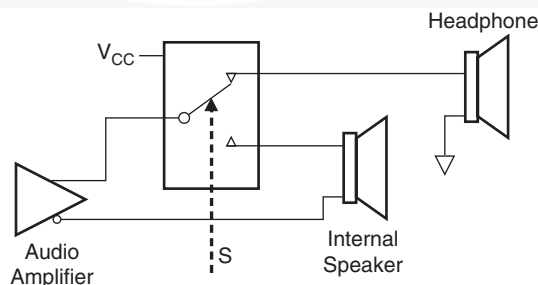


Figure 1. Application Diagram

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### Pin Assignments

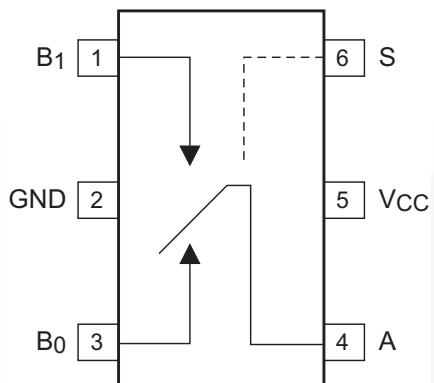


Figure 2. 6-Lead SC70

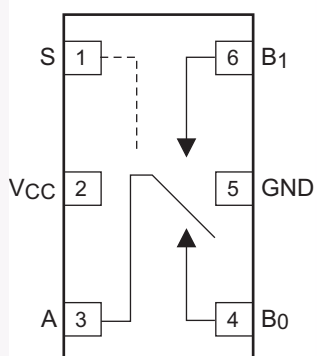


Figure 3. 6-Lead MicroPak™

### Truth Tables

Control Input(s)	Function
LOW Logic Level	B <sub>0</sub> Connected to A
HIGH Logic Level	B <sub>1</sub> Connected to A

### Pin Descriptions

Pin Names	Function
A, B <sub>0</sub> , B <sub>1</sub>	Data Ports
S	Control Input

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Min.	Max	Units
$V_{CC}$	Supply Voltage	-0.5	5.5	V
$V_S$	Switch Voltage <sup>(1)</sup>	-0.5	$V_{CC} + 0.3V$	V
$V_{IN}$	Input Voltage <sup>(1)</sup>	-0.5	$V_{CC}$	V
$I_{IK}$	Input Diode Current		-50	mA
$I_{SW}$	Switch Current		350	mA
$I_{SWPEAK}$	Peak Switch Current (Pulsed at 1ms duration, <10% Duty Cycle)		500	mA
$P_D$	SC70 6L Package		180	mW
	MicroPak 6L Package		180	mW
$T_{STG}$	Storage Temperature Range	-65	+150	°C
$T_J$	Maximum Junction Temperature		+150	°C
$T_L$	Lead Temperature Soldering, 10 seconds		+260	°C
ESD	Human Body Model		8000	V

### Note:

- The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Min.	Max.	Rating
$V_{CC}$	Supply Voltage	1.65	4.30	V
$V_{IN}$	Control Input Voltage <sup>(2)</sup>	0	$V_{CC}$	V
$V_{IN}$	Switch Input Voltage	0	$V_{CC}$	V
$T_A$	Operating Temperature	-40	+85	°C

### Note:

- Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

All typical values are at 25°C unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> =+25°C			T <sub>A</sub> = -40°C to +85°C		Units
				Min.	Typ.	Max.	Min.	Max.	
V <sub>IH</sub>	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 <sub>IL</sub>	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 <sub>IN</sub>	Control Input Leakage	V <sub>IN</sub> = 0V to V <sub>CC</sub>	1.65 to 4.3				-0.5	0.5	μA
I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub>	Off-Leakage Current of Port B <sub>0</sub> and B <sub>1</sub>	A = 0.3V, V <sub>CC</sub> = 0.3V, B <sub>0</sub> or B <sub>1</sub> = 0.3V, V <sub>CC</sub> = 0.3V or Floating	1.95 to 4.3	-10		10	-50	50	nA
I <sub>A(ON)</sub>	On Leakage Current of Port A	A = 0.3V, V <sub>CC</sub> = 0.3V, B <sub>0</sub> or B <sub>1</sub> = 0.3V, V <sub>CC</sub> = 0.3V or Floating	1.95 to 4.3	-20		20	-100	100	nA
R <sub>ON</sub>	Switch On Resistance <sup>(3)</sup>	I <sub>OUT</sub> = 100mA, B <sub>0</sub> or B <sub>1</sub> = 0V, 0.7V, 3.6V, 4.3V	4.3		0.36			0.60	Ω
			2.7		0.4			0.7	
			2.3		0.55			0.80	
			1.65	1.5	2.5		3.0		
ΔR <sub>ON</sub>	On Resistance Matching Between Channels <sup>(4)</sup>	I <sub>OUT</sub> = 100mA, B <sub>0</sub> or B <sub>1</sub> = 0.7V	4.3		0.04			0.75	Ω
			2.7		0.06			0.13	
			2.3		0.12			0.20	
			1.65	1.0					
R <sub>FLAT(ON)</sub>	On Resistance Flatness <sup>(5)</sup>	I <sub>OUT</sub> = 100mA, B <sub>0</sub> or B <sub>1</sub> = 0V to V <sub>CC</sub>	4.3					0.25	Ω
			2.7					0.25	
			2.3					0.3	
			1.65	0.3					
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = 0V or V <sub>CC</sub> , I <sub>OUT</sub> = 0	4.3	-100	30	100	-500	500	nA
I <sub>CCT</sub>	Increase in I <sub>CC</sub> per Control Input	V <sub>IN</sub> = 1.8V	4.3		7.0	12.0		15.0	μA
		V <sub>IN</sub> = 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<sub>ON</sub> = R<sub>ONmax</sub> - R<sub>ONmin</sub> measured at identical V<sub>CC</sub>, 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 at 25°C unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40°C to +85°C		Units	Figure
				Min.	Typ.	Max.	Min.	Max.		
t <sub>ON</sub>	Turn-On Time	B <sub>0</sub> or B <sub>1</sub> = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF	3.6 to 4.3			55		60	ns	Figure 7
			2.7 to 3.6			60		65		
			2.3 to 2.7			65		70		
			1.65 to 1.95		70		90			
t <sub>OFF</sub>	Turn-Off Time	B <sub>0</sub> or B <sub>1</sub> = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF	3.6 to 4.3			30		35	ns	Figure 7
			2.7 to 3.6			35		40		
			2.3 to 2.7			40		45		
			1.65 to 1.95		40		55			
t <sub>BBM</sub>	Break-Before-Make Time	B <sub>0</sub> or B <sub>1</sub> = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF	3.6 to 4.3				5		ns	Figure 8
			2.7 to 3.6				5			
			2.3 to 2.7				5			
			1.65 to 1.95				5			
Q	Charge Injection	C <sub>L</sub> = 1.0 nF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω	3.6 to 4.3		6				pC	Figure 11
			2.7 to 3.6		6					
			2.3 to 2.7		6					
			1.65 to 1.95							
OIRR	Off-Isolation	f = 100kHz, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF (Stray)	3.6 to 4.3		-75				dB	Figure 9
			2.7 to 3.6		-75					
			2.3 to 2.7		-75					
			1.65 to 1.95		-75					
Xtalk	Crosstalk	f = 100kHz, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF (Stray)	3.6 to 4.3		-75				dB	Figure 10
			2.7 to 3.6		-75					
			2.3 to 2.7		-75					
			1.65 to 1.95		-70					
BW	-3db Bandwidth	R <sub>L</sub> = 50Ω	1.65 to 4.3		80				MHz	Figure 13
THD	Total Harmonic Distortion	R <sub>L</sub> = 32Ω, V <sub>IN</sub> = 2V <sub>PP</sub> , f = 20Hz to 20kHz	3.6 to 4.3						%	Figure 14
			2.7 to 3.6		0.02					
			2.3 to 2.7		0.036					
			1.65 to 1.95		0.01					

## Capacitance

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = +25°C			T <sub>A</sub> = 40°C to +85°C		Units	Figure
				Min.	Typ.	Max.	Min.	Max.		
C <sub>IN</sub>	Control Pin Input Capacitance	f = 1MHz	0.0		1.5				pF	Figure 12
C <sub>OFF</sub>	B Port OFF Capacitance	f = 1MHz	4.5		21.0				pF	Figure 12
C <sub>ON</sub>	A Port ON Capacitance	f = 1MHz	4.5		90.0				pF	Figure 12

Typical Characteristics

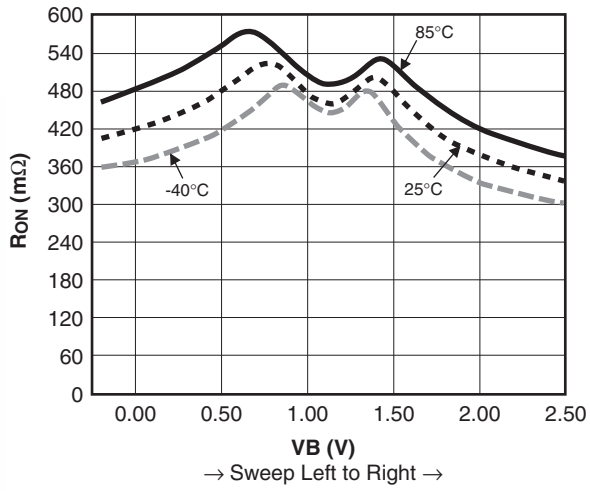


Figure 4.  $R_{ON}$  Switch On Resistance,  $I_{ON} = 100\text{mA}$ ,  $V_{CC} = 2.3\text{V B0}$

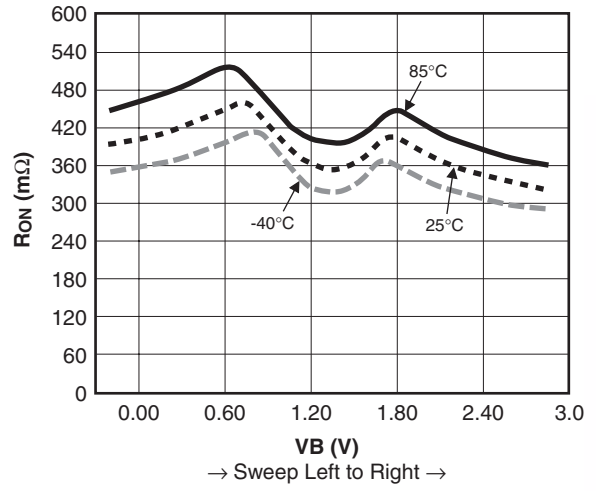


Figure 5.  $R_{ON}$  Switch On Resistance,  $I_{ON} = 100\text{mA}$ ,  $V_{CC} = 2.7\text{V B0}$

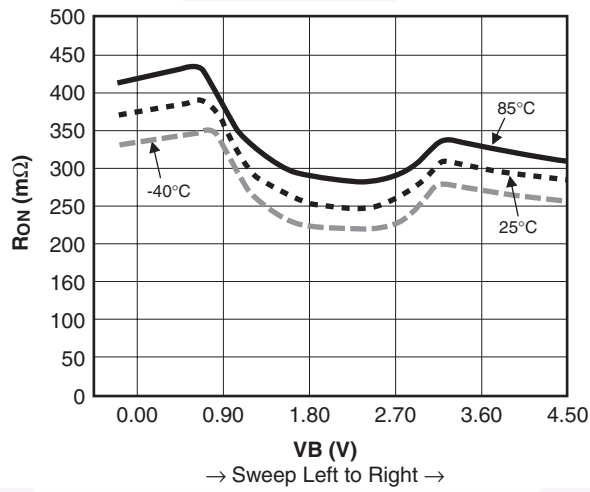
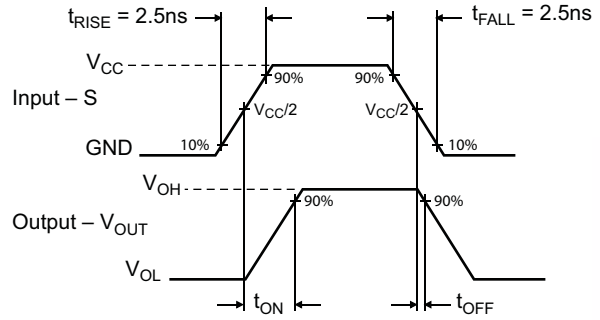
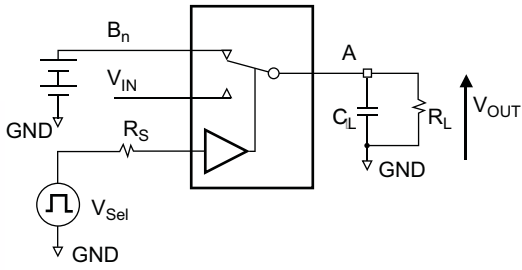


Figure 6.  $R_{ON}$  Switch On Resistance,  $I_{ON} = 100\text{mA}$ ,  $V_{CC} = 4.3\text{V B0}$

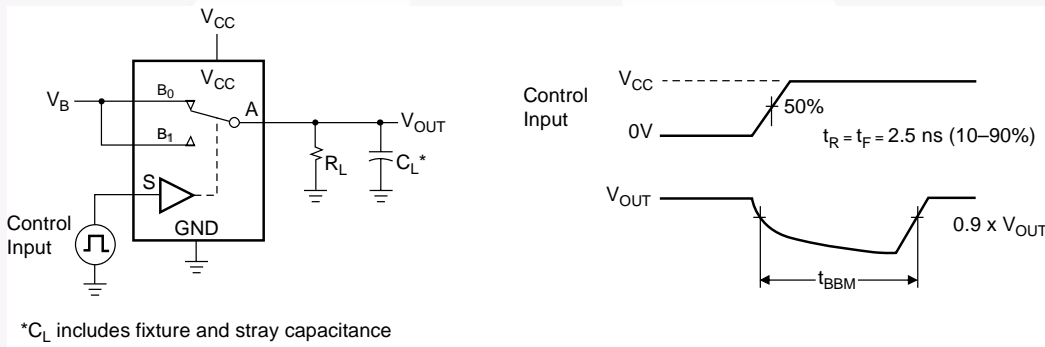
### AC Loading and Waveforms



**Notes:**

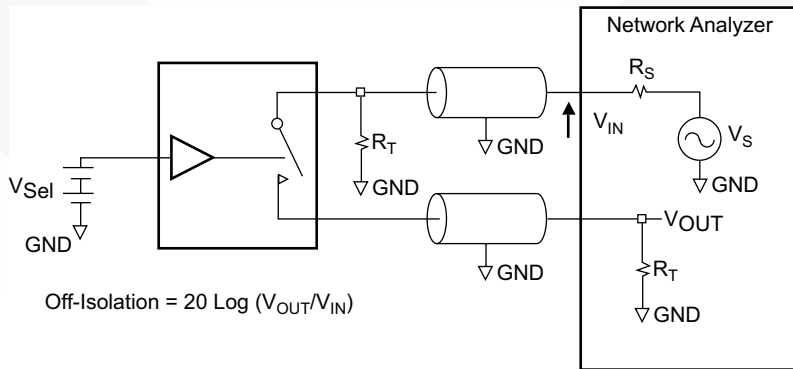
- 6.  $R_L$ ,  $R_S$ , and  $C_L$  are functions of the application environment (see AC Electrical table for specific values).
- 7.  $C_L$  includes test fixture and stray capacitance.

**Figure 7. Turn-Off Timing**



\* $C_L$  includes fixture and stray capacitance

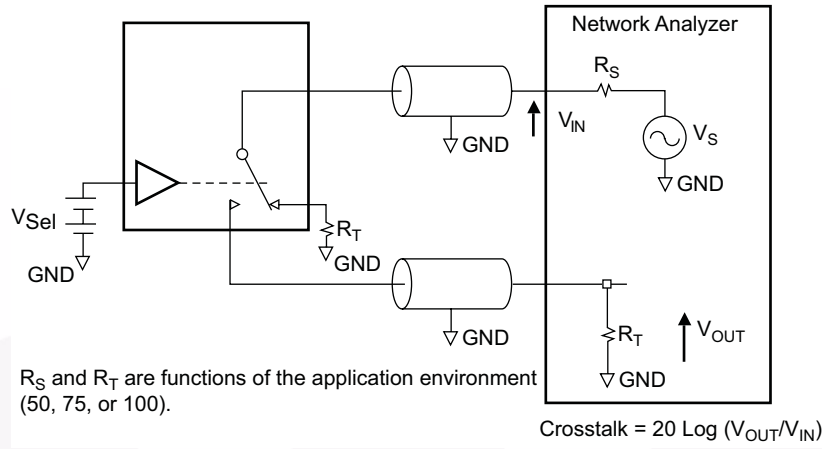
**Figure 8. Break-Before-Make Timing**



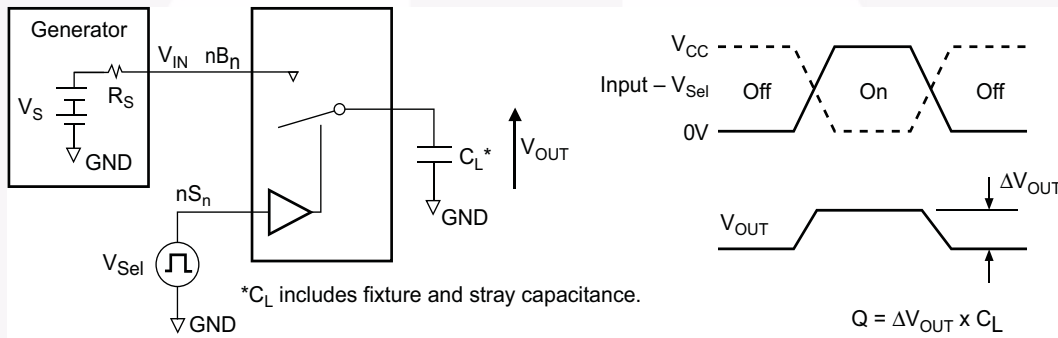
**Figure 9. Off Isolation**



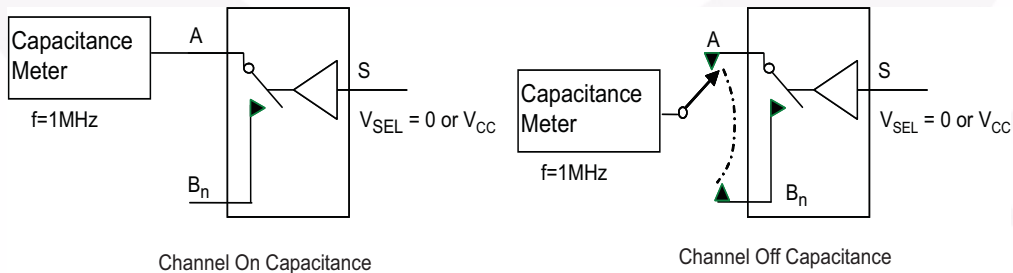
**AC Loading and Waveforms** (continued)



**Figure 10. Non-Adjacent Channel-to-Channel Crosstalk**



**Figure 11. Charge Injection Test**



**Figure 12. On/Off Capacitance Measurement Setup**

AC Loading and Waveforms (continued)

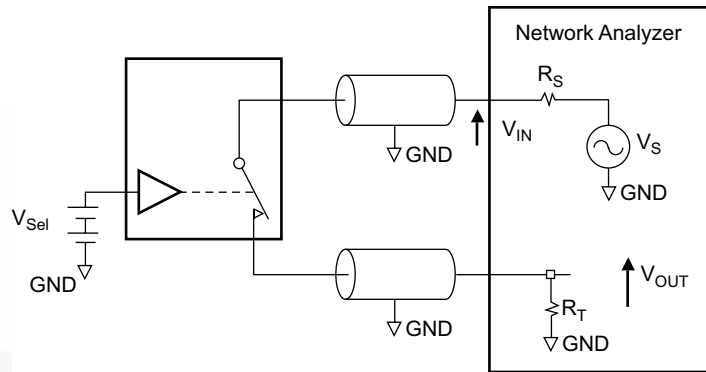


Figure 13. Bandwidth

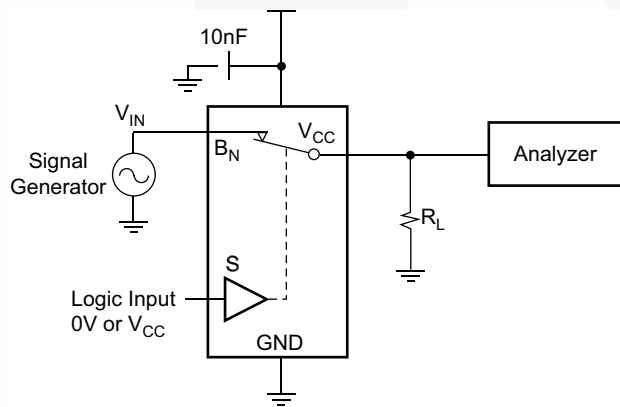
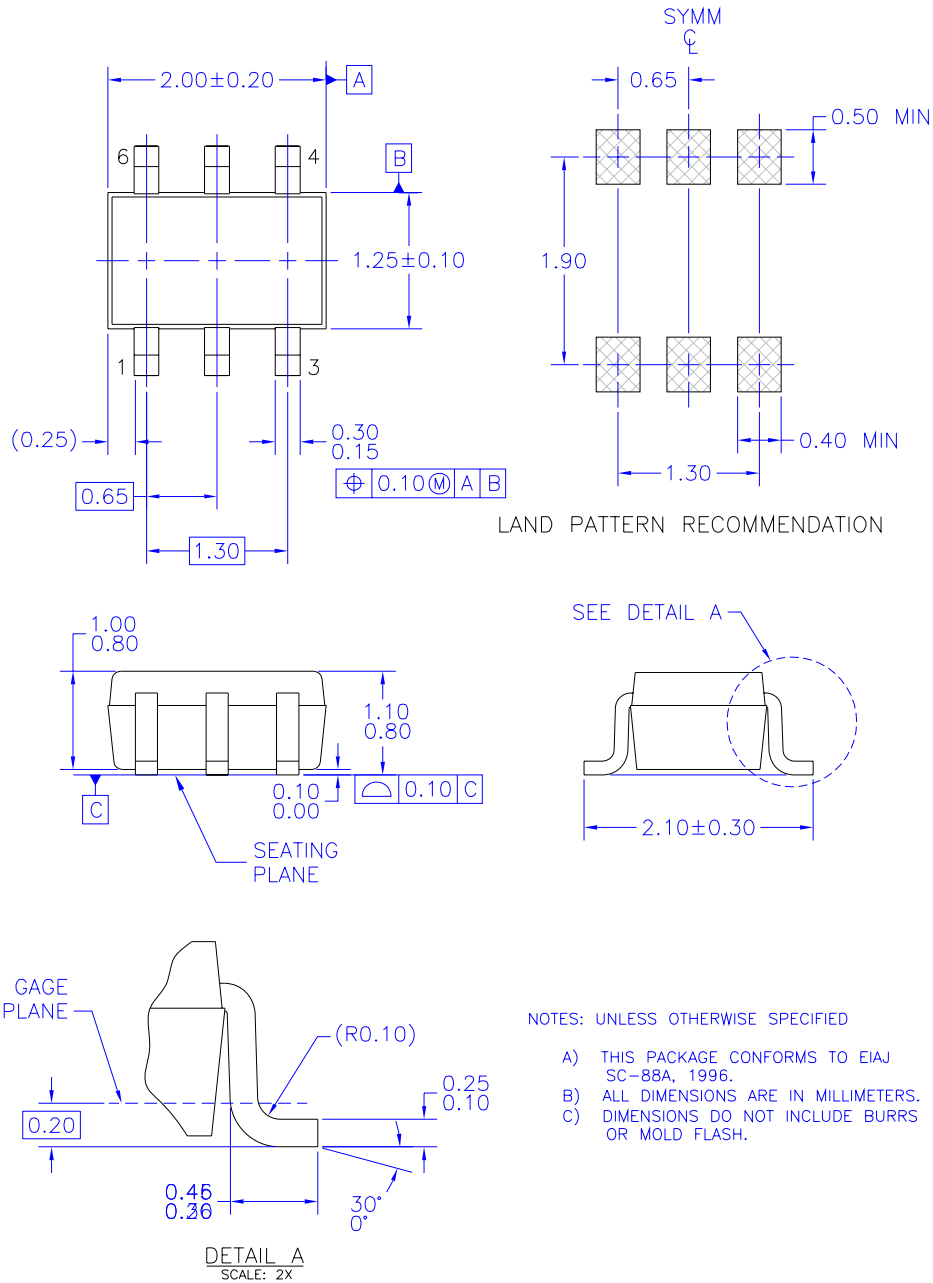


Figure 14. Harmonic Distortion



## Physical Dimensions



MAA06AREV5

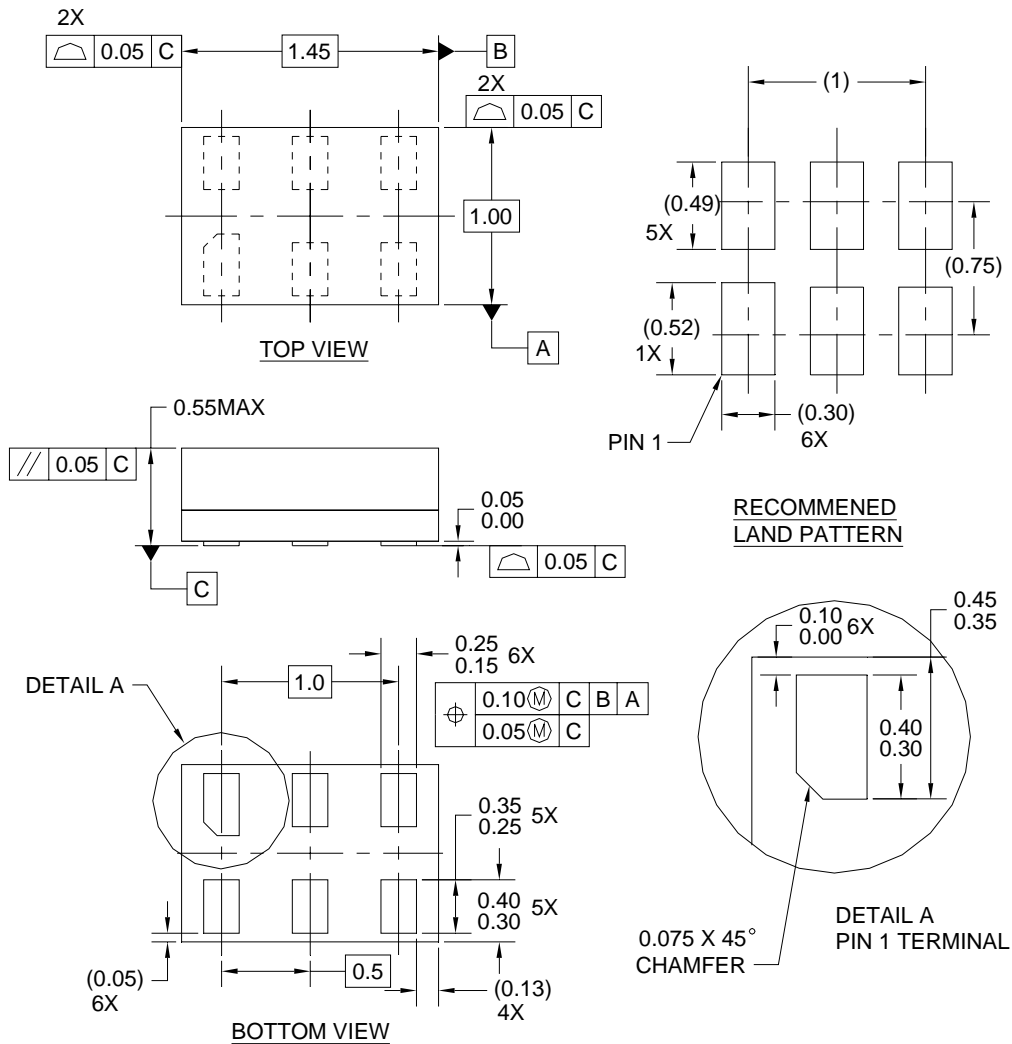
**Figure 15. 6-Lead SC70, EIAJ SC88, 1.25mm Wide**

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## Physical Dimensions



**Notes:**

1. CONFORMS TO JEDEC STANDARD M0-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-1994

MAC06AREVC

**Figure 16. 6-Lead MicroPak™, 1.0mm Wide**

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