

# Low-Voltage 0.4 $\Omega$ SPDT Analog Switch

## FSA5157

### 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  $\Omega$  impedance, sub- $\mu$ A current consumption, and 1.65 V to 4.3 V 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 1.8 V, 2.5 V, and 3.3 V.

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 100  $\mu$ A 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 <12  $\mu$ A under a worst-case condition of  $V_{CC} = 4.3$  V and  $V_{IN} = 1.8$  V.

### Features

- Typical 0.4  $\Omega$  On Resistance ( $R_{ON}$ ) for +2.7 V Supply
- FSA5157 Features Less than 12  $\mu$ A  $I_{CCT}$  Current When S Input is Lower than  $V_{CC}$
- 0.25  $\Omega$  Maximum  $R_{ON}$  Flatness for +2.7 V Supply
- 1.45 x 1 mm 6-Lead Package
- Broad  $V_{CC}$  Operating Range: 1.65 V to 4.3 V
- Low THD (0.02% Typical for 32  $\Omega$  Load)
- High-Current Handling Capability (350 mA Continuous Current under 3.3 V Supply)
- Control Logic is 1.8 V CMOS Logic Compatible
- These Devices are Pb-Free and are RoHS Compliant

### APPLICATION DIAGRAM

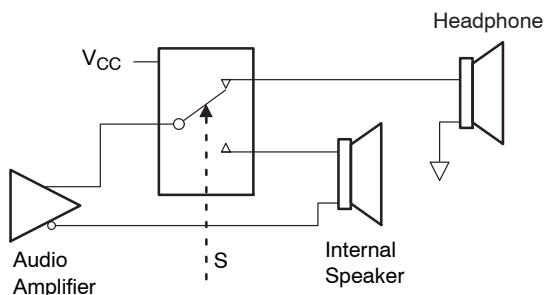


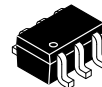
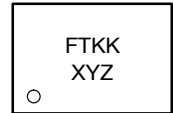
Figure 1. Application Diagram

### MARKING DIAGRAMS



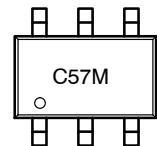
SIP6 1.45x1.0  
CASE 127EB

FT = Specific Device Code  
 KK = 2-Digits Lot Run Traceability Code  
 XY = 2-Digit Date Code  
 Z = Assembly Plant Code



SC-88/SC-70  
6 Lead, 1.25x2  
CASE 419AD

C57 = Specific Device Code  
 M = Assembly Operation Month



\*Date Code orientation and/or position may vary depending upon manufacturing location.

### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

### Applications

- Cellular Phone
- PDA
- Portable Media Player

## PIN CONFIGURATIONS

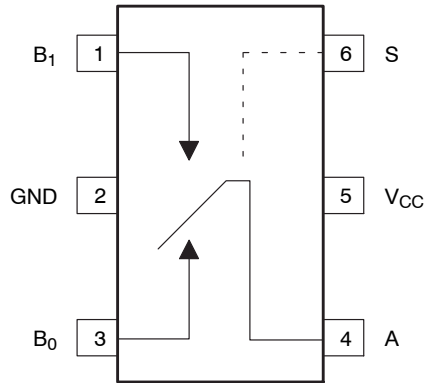


Figure 2. 6-Lead SC70

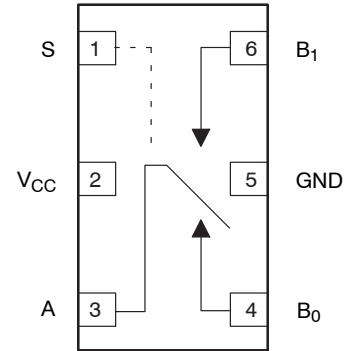


Figure 3. SIP6

## PIN DEFINITIONS

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

## TRUTH TABLE

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

## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	Supply Voltage	-0.5	5.5	V
V <sub>S</sub>	Switch Voltage (Note 1)	-0.5	V <sub>CC</sub> + 0.3 V	V
V <sub>IN</sub>	Input Voltage (Note 1)	-0.5	V <sub>CC</sub>	V
I <sub>IK</sub>	Input Diode Current		-50	mA
I <sub>SW</sub>	Switch Current		350	mA
I <sub>SWPEAK</sub>	Peak Switch Current (Pulsed at 1 ms Duration, < 10% Duty Cycle)		500	mA
P <sub>D</sub>	SC70 6L Package		180	mW
	SIP6 Package		180	mW
T <sub>STG</sub>	Storage Temperature Range	-65	+150	°C
T <sub>J</sub>	Maximum Junction Temperature		+150	°C
T <sub>L</sub>	Lead Temperature Soldering, 10 seconds		+260	°C
ESD	Human Body Model		8000	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	Supply Voltage	1.65	4.30	V
V <sub>IN</sub>	Control Input Voltage (Note 2)	0	V <sub>CC</sub>	V
V <sub>IN</sub>	Switch Input Voltage	0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature	-40	+85	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

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

# FSA5157

## 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		Unit
				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> = 0 V 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 = 0.3 V, V <sub>CC</sub> -0.3 V, B <sub>0</sub> or B <sub>1</sub> = 0.3 V, V <sub>CC</sub> -0.3 V or Floating	1.95 to 4.3	-10		10	-50	50	nA
I <sub>A(ON)</sub>	On Leakage Current of Port A	A = 0.3 V, V <sub>CC</sub> -0.3 V, B <sub>0</sub> or B <sub>1</sub> = 0.3 V, V <sub>CC</sub> -0.3 V or Floating	1.95 to 4.3	-20		20	-100	100	nA
R <sub>ON</sub>	Switch On Resistance (Note 3)	I <sub>OUT</sub> = 100 mA, B <sub>0</sub> or B <sub>1</sub> = 0 V, 0.7 V, 3.6 V, 4.3 V	4.3		0.36			0.60	Ω
		I <sub>OUT</sub> = 100 mA, B <sub>0</sub> or B <sub>1</sub> = 0 V, 0.7 V, 2.0 V, 2.7 V	2.7		0.4			0.70	
		I <sub>OUT</sub> = 100 mA, B <sub>0</sub> or B <sub>1</sub> = 0 V, 0.7 V, 2.0 V, 2.3 V	2.3		0.55			0.80	
		I <sub>OUT</sub> = 100 mA, B <sub>0</sub> or B <sub>1</sub> = 0.7 V	1.65		1.5	2.5		3.0	
ΔR <sub>ON</sub>	On Resistance Matching Between Channels (Note 4)	I <sub>OUT</sub> = 100 mA, B <sub>0</sub> or B <sub>1</sub> = 0.7 V	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 (Note 5)	I <sub>OUT</sub> = 100 mA, B <sub>0</sub> or B <sub>1</sub> = 0 V 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> = 0 V or V <sub>CC</sub> , I <sub>OUT</sub> = 0	4.3	-100	30	100	-500	500	nA
I <sub>CCCT</sub>	Increase in I <sub>CC</sub> per Control Input	V <sub>IN</sub> = 1.8 V	4.3		7.0	12.0		15.0	μA
		V <sub>IN</sub> = 2.6 V	4.3		3.0	6.0		7.0	

3. On resistance is determined by the voltage drop between the A and B pins at the indicated current through the switch.

4. ΔR<sub>ON</sub> = R<sub>ONmax</sub> - R<sub>ONmin</sub> measured at identical V<sub>CC</sub>, temperature, and voltage.

5. Flatness is defined as the difference between the maximum and minimum value of on resistance over the specified range of conditions.

# FSA5157

## 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		Unit	Figure
				Min	Typ	Max	Min	Max		
t <sub>ON</sub>	Turn-On Time	B <sub>0</sub> or B <sub>1</sub> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF	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> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF	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> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF	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> = 0 V, R <sub>GEN</sub> = 0 Ω	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 = 100 kHz, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF (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 = 100 kHz, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF (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> = 50 Ω	1.65 to 4.3		80				MHz	Figure 13
THD	Total Harmonic Distortion		3.6 to 4.3						%	Figure 14
		R <sub>L</sub> = 32 Ω, V <sub>IN</sub> = 2V <sub>PP</sub> , f = 20 Hz to 20 kHz	2.7 to 3.6		0.02					
		R <sub>L</sub> = 32 Ω, V <sub>IN</sub> = 1.5V <sub>PP</sub> , f = 20 Hz to 20 kHz	2.3 to 2.7		0.036					
		R <sub>L</sub> = 32 Ω, V <sub>IN</sub> = 1.2V <sub>PP</sub> , f = 20 Hz to 20 kHz	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		Unit	Figure
				Min	Typ	Max	Min	Max		
C <sub>IN</sub>	Control Pin Input Capacitance	f = 1 MHz	0.0		1.5				pF	Figure 12
C <sub>OFF</sub>	B Port OFF Capacitance	f = 1 MHz	4.5		21.0				pF	Figure 12
C <sub>ON</sub>	A Port ON Capacitance	f = 1 MHz	4.5		90.0				pF	Figure 12

## TYPICAL CHARACTERISTICS

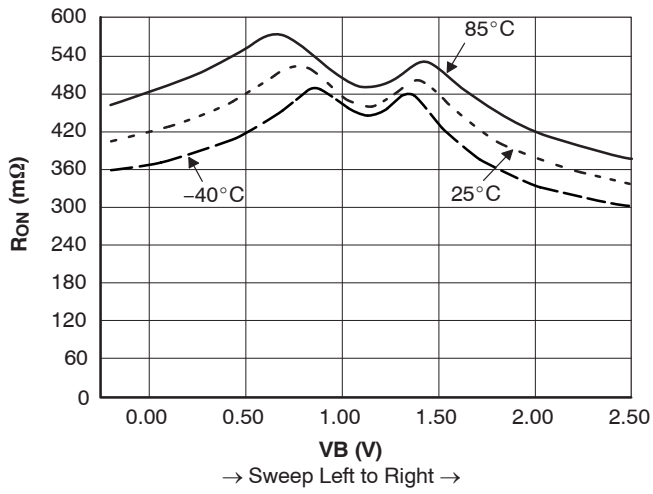


Figure 4.  $R_{ON}$  Switch On Resistance,  
 $I_{ON} = 100 \text{ mA}$ ,  $V_{CC} = 2.3 \text{ V B0}$

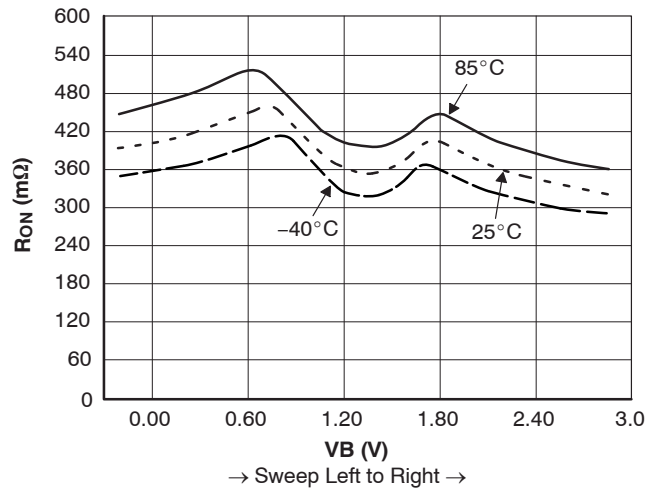


Figure 6.  $R_{ON}$  Switch On Resistance,  
 $I_{ON} = 100 \text{ mA}$ ,  $V_{CC} = 2.7 \text{ V B0}$

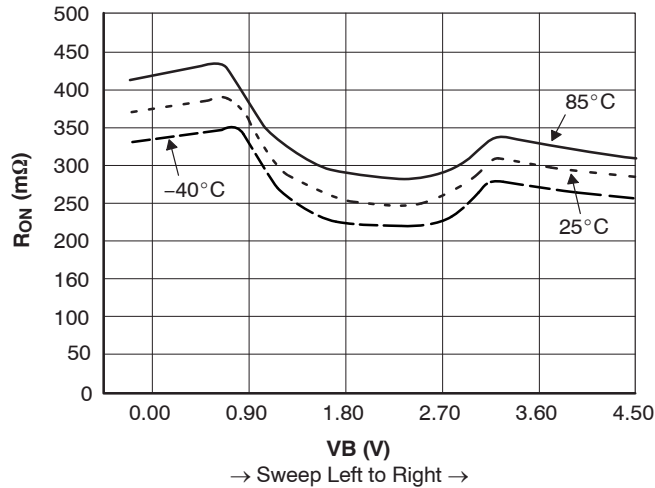
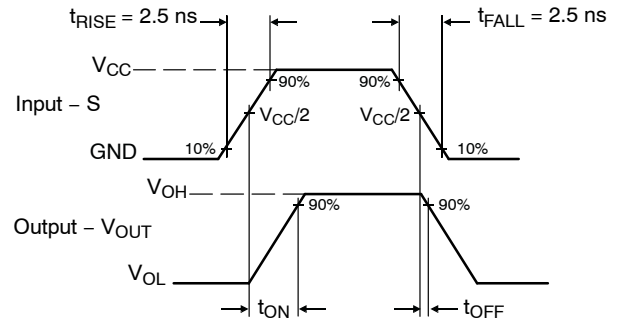
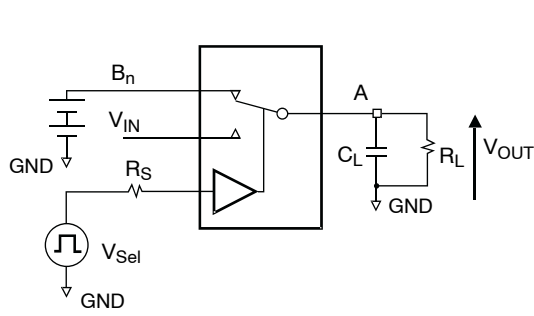


Figure 5.  $R_{ON}$  Switch On Resistance,  
 $I_{ON} = 100 \text{ mA}$ ,  $V_{CC} = 4.3 \text{ V B0}$

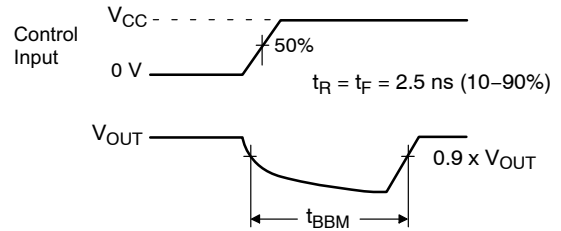
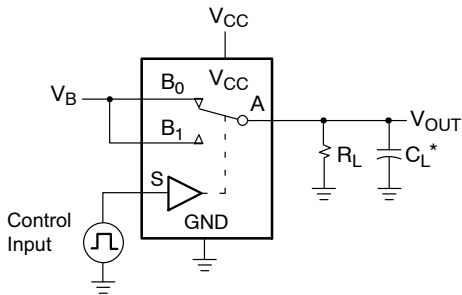
## AC LOADINGS AND WAVEFORMS



## NOTES:

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

Figure 7. Turn-Off Timing



\* $C_L$  includes test fixture and stray capacitance.

Figure 8. Break-Before-Make Timing

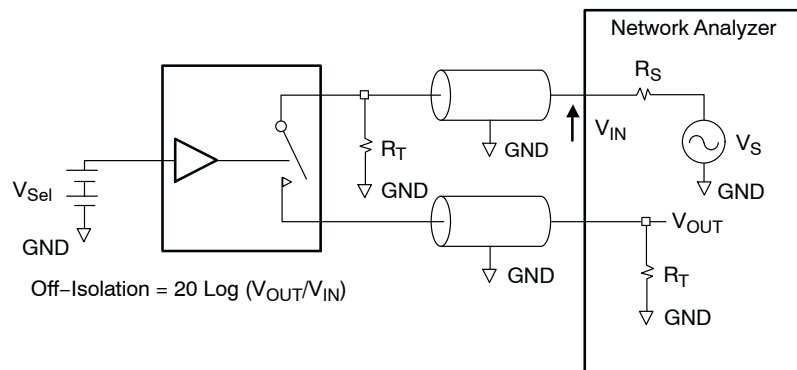


Figure 9. Off Isolation

## AC LOADINGS AND WAVEFORMS (Continued)

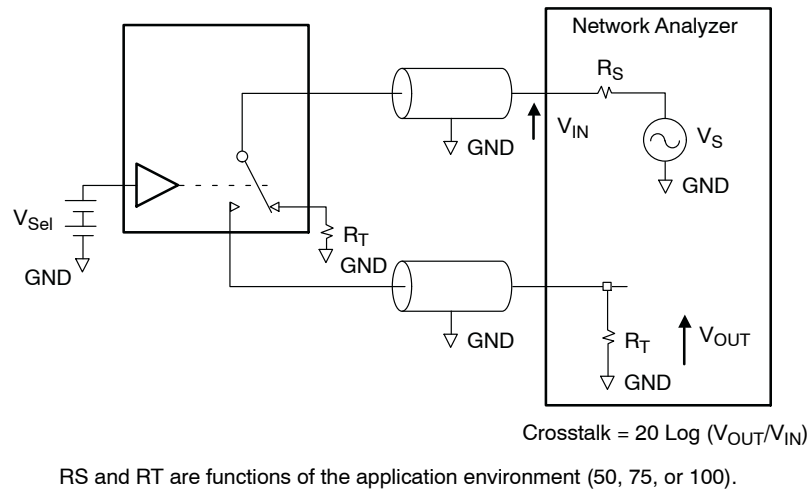
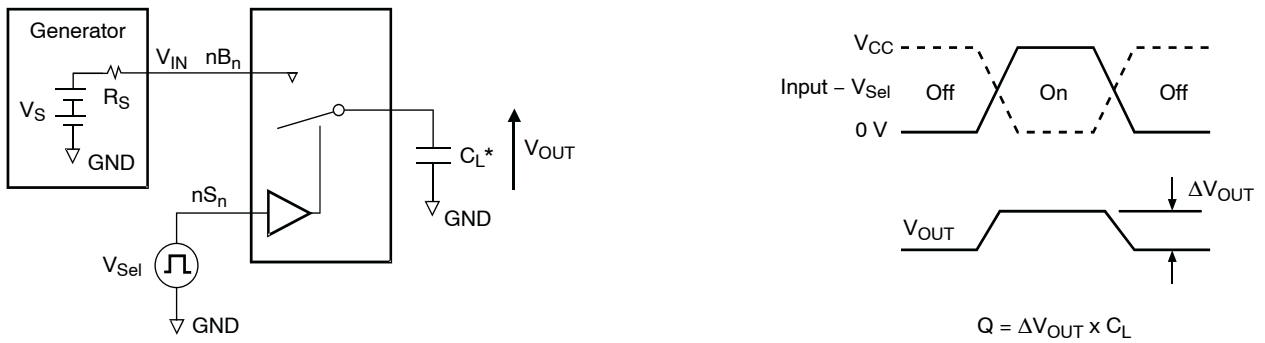


Figure 10. Non-Adjacent Channel-to-Channel Crosstalk



\* $C_L$  includes fixture and stray capacitance.

Figure 11. Charge Injection Test

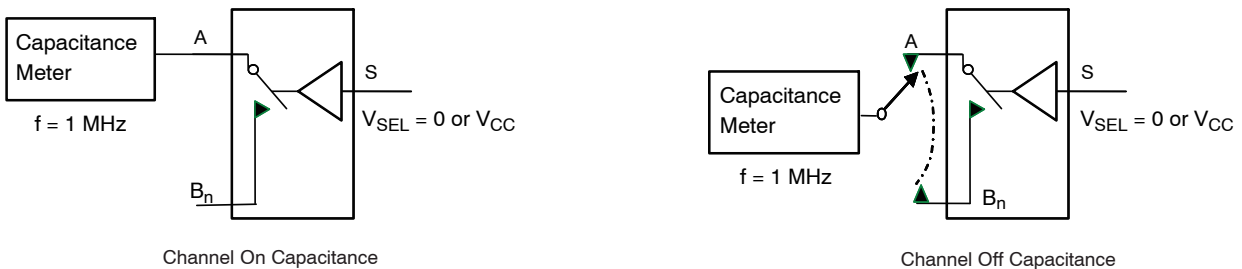


Figure 12. On/Off Capacitance Measurement Setup

# FSA5157

## AC LOADINGS AND WAVEFORMS (Continued)

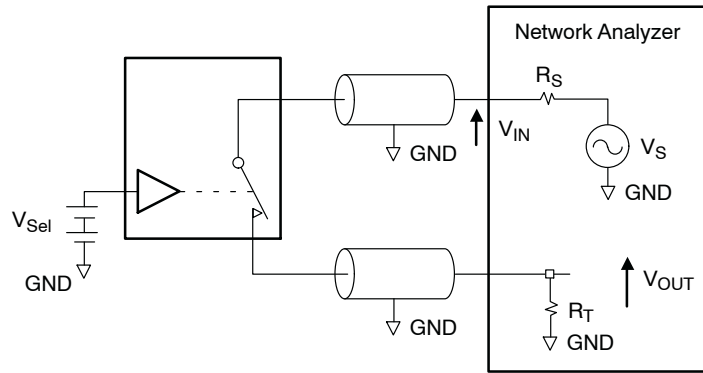


Figure 13. Bandwidth

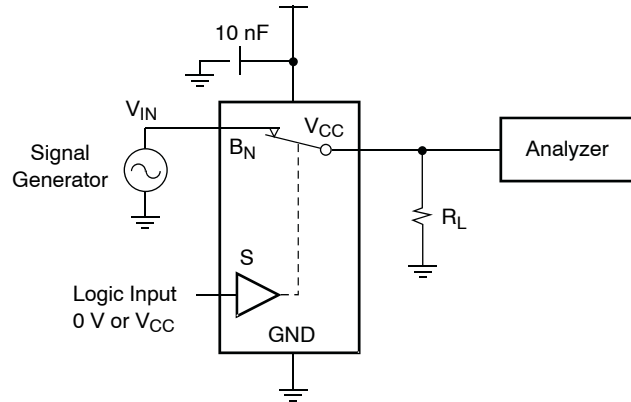


Figure 14. Harmonic Distortion

## ORDERING INFORMATION

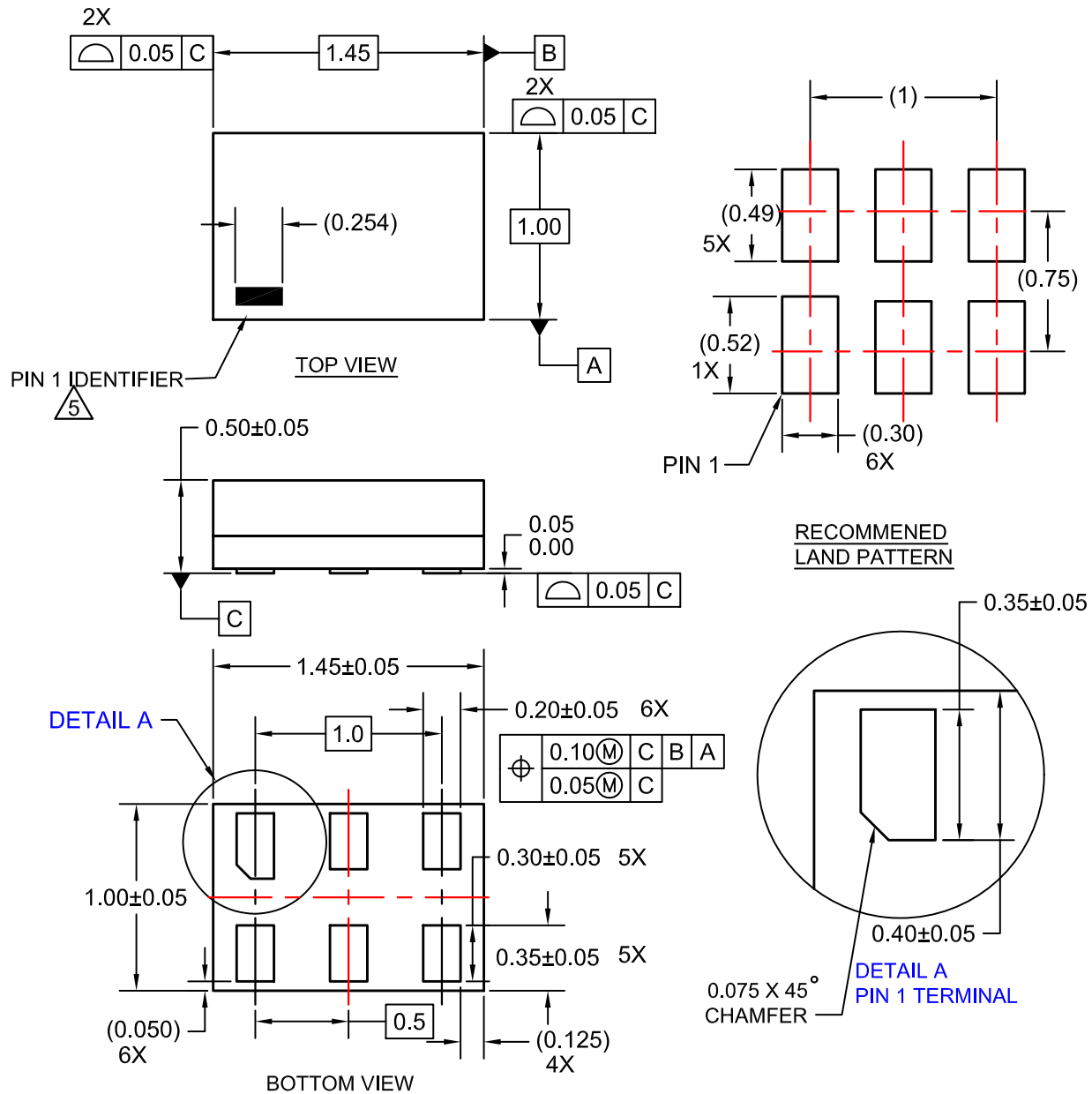
Part Number	Top Mark	Package	Shipping†
FSA5157P6X	C57	SC-88/SC-70 6 Lead, 1.25x2 (Pb-Free)	3000 / Tape & Reel
FSA5157L6X	FT	SIP6 1.45x1.0 (Pb-Free)	5000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



**SIP6 1.45X1.0**  
**CASE 127EB**  
**ISSUE O**

DATE 31 AUG 2016

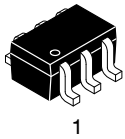


**NOTES:**

1. CONFORMS TO JEDEC STANDARD MO-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-2009
4. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY OTHER LINE IN THE MARK CODE LAYOUT.

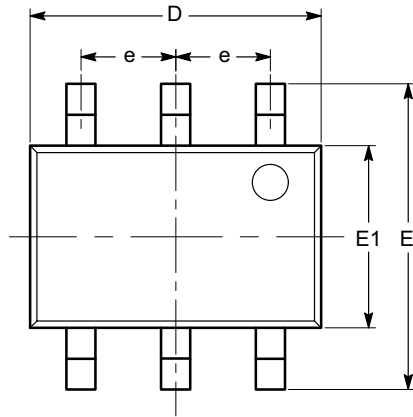
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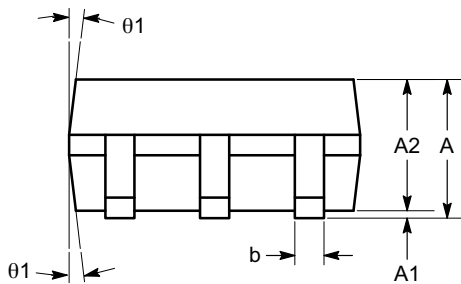


**SC-88 (SC-70 6 Lead), 1.25x2**  
CASE 419AD  
ISSUE A

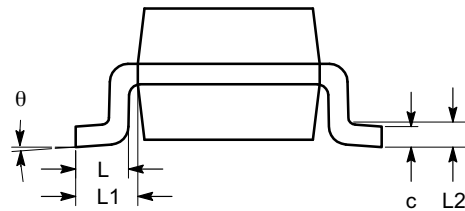
DATE 07 JUL 2010



**TOP VIEW**



**SIDE VIEW**



**END VIEW**

SYMBOL	MIN	NOM	MAX
A	0.80		1.10
A1	0.00		0.10
A2	0.80		1.00
b	0.15		0.30
c	0.10		0.18
D	1.80	2.00	2.20
E	1.80	2.10	2.40
E1	1.15	1.25	1.35
e	0.65 BSC		
L	0.26	0.36	0.46
L1	0.42 REF		
L2	0.15 BSC		
θ	0°		8°
θ1	4°		10°

**Notes:**

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MO-203.

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