

# Low-Voltage, 1 $\Omega$ SPDT Analog Switch

## FSA4157, FSA4157A

### Description

FSA4157 and FSA4157A are high performance Single Pole/Double Throw (SPDT) analog switches. Both devices feature ultra low  $R_{ON}$  of 1.15  $\Omega$  maximum at 4.5 V  $V_{CC}$  and operates over the wide  $V_{CC}$  range of 1.65 V to 5.5 V for FSA4157, and 2.7 V to 5.5 V 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  $\Omega$  On Resistance ( $R_{ON}$ ) at 4.5 V  $V_{CC}$
- 0.3  $\Omega$  Maximum  $R_{ON}$  Flatness at 4.5 V  $V_{CC}$
- Space-Saving 6-lead, MicroPak™ and SC70 6 Packages
- Broad  $V_{CC}$  Operating Range:
  - ◆ FSA4157: 1.65 V to 5.5 V
  - ◆ FSA4157A: 2.7 V to 5.5 V
- Fast Turn-On and Turn-Off Time
- Break-Before-Make Enable Circuitry
- Over-Voltage Tolerant TTL-Compatible Control Circuitry
- These Devices are Pb-Free and are RoHS Compliant

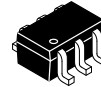


SIP6 1.45X1.0  
 CASE 127EB

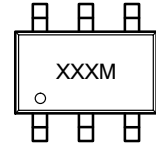
### MARKING DIAGRAMS



- XX = Specific Device Code (EG, EU)
- &K = 2-Digits Lot Run Traceability Code
- &2 = 2-Digit Date Code
- &Z = Assembly Plant Code



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



- XXX = Specific Device Code (A57, B57)
- 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 2 of this data sheet.

# FSA4157, FSA4157A

## ORDERING INFORMATION

Part Number	Top Mark	Package	Shipping†
FSA4157L6X	EG	SIP6 1.45X1.0 (Pb-Free)	5000 / Tape & Reel
FSA4157AL6X	EU	SIP6 1.45X1.0 (Pb-Free)	5000 / Tape & Reel
FSA4157P6X	A57	SC-88 (SC-70 6 Lead), 1.25x2 (Pb-Free)	3000 / Tape & Reel
FSA4157AP6X	B57	SC-88 (SC-70 6 Lead), 1.25x2 (Pb-Free)	3000 / 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.

## PIN CONFIGURATIONS

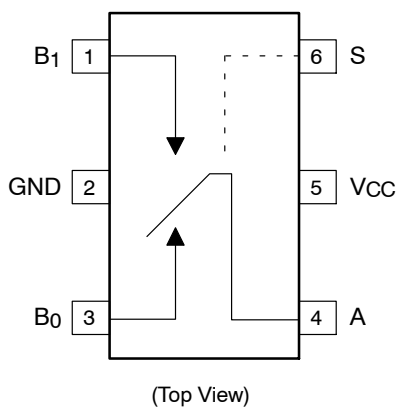


Figure 1. SC70 Pin Assignments

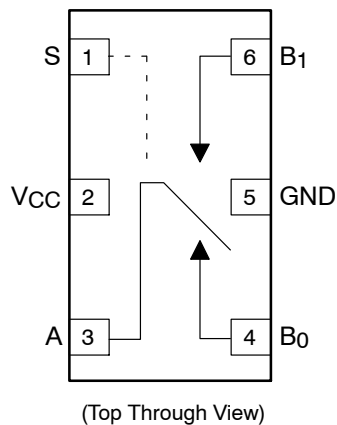


Figure 2. MicroPak Pin Assignments

## PIN DEFINITIONS

Pin# SC70	Pin# MicroPak	Name	Description
1	6	B1	Data Ports
2	5	GND	Ground
3	4	B0	Data Ports
4	3	A	Data Ports
5	2	V <sub>CC</sub>	Supply Voltage
6	1	S	Control Input

## TRUTH TABLE

Control Input (S)	Function
Low	B0 connected to A
High	B1 connected to A

# FSA4157, FSA4157A

## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	Supply Voltage	-0.5	6.0	V
V <sub>S</sub>	DC Switch Voltage (Note 1)	-0.5	V <sub>CC</sub> + 0.5	V
V <sub>IN</sub>	DC Input Voltage (Note 1)	-0.5	6.0	V
I <sub>IK</sub>	DC Input Diode Current	-50		mA
I <sub>SW</sub>	Switch Current		200	mA
I <sub>SWPEAK</sub>	Peak Switch Current (Pulse at 1 ms duration, < 10% Duty Cycle)		400	mA
P <sub>D</sub>	Power Dissipation at 85°C SC70 MicroPak		180 180	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	Electrostatic Discharge Capability	Human Body Model, JESD22-A114 (FSA4157A)		7500 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. Input and output negative ratings may be exceeded if input and output diode current ratings are observed.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit	
V <sub>CC</sub>	Supply Voltage	FSA4157	1.65	5.50	V
		FSA4157A	2.7	5.5	
V <sub>CNTRL</sub>	Control Input Voltage (Note 2)	0	V <sub>CC</sub>	V	
V <sub>SW</sub>	Switch Input Voltage	0	V <sub>CC</sub>	V	
T <sub>A</sub>	Operating Temperature	-40	+85	°C	
θ <sub>JA</sub>	Thermal Resistance in Still Air	SC70		350	°C/W
		MicroPak (Estimated)		330	

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

# FSA4157, FSA4157A

## DC ELECTRICAL CHARACTERISTICS

(Typical values are at 25°C unless otherwise specified.)

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	Ambient Temperature					Unit
				-25°C			-40 to +85°C		
				Min.	Typ.	Max.	Min.	Max.	
V <sub>IH</sub>	Input Voltage High	FSA4157 Only	1.8 to 2.7				1.0		V
			2.7 to 3.6				2.0		
			4.5 to 5.5				2.4		
V <sub>IL</sub>	Input Voltage Low	FSA4157 Only	1.8 to 2.7					0.4	V
		FSA4157A Only	2.7 to 3.6					0.4	
			2.7 to 3.6					0.6	
			4.5 to 5.5					0.8	
I <sub>IN</sub>	Control Input Leakage	V <sub>IN</sub> = 0 V to V <sub>CC</sub>	2.7 to 3.6				-1.0	1.0	μA
			4.5 to 5.5				-1.0	1.0	
I <sub>NO(OFF)</sub> , I <sub>NC(OFF)</sub>	Off Leakage Current of Port B0 and B1	A = 1 V, 4.5 V, B <sub>0</sub> or B <sub>1</sub> = 4.5, 1 V	5.5		±2		-20	20	nA
I <sub>A(ON)</sub>	On Leakage Current of Port A	A = 1 V, 4.5V, B <sub>0</sub> or B <sub>1</sub> = 4.5, 1 V, 4.5 V or Floating	5.5		±4		-40	40	nA
R <sub>ON</sub>	Switch On Resistance	I <sub>OUT</sub> = 100 mA, B <sub>0</sub> or B <sub>1</sub> = 1.5 V	2.7		2.6	4.0		4.3	Ω
		I <sub>OUT</sub> = 100 mA, B <sub>0</sub> or B <sub>1</sub> = 3.5 V	4.5		0.95	1.15		1.30	
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> = 1.5 V	4.5		0.06	0.12		0.15	Ω
R <sub>FLAT(ON)</sub>	On Resistance Flatness (Note 4)	I <sub>OUT</sub> = 100 mA, B <sub>0</sub> or B <sub>1</sub> = 0 V, 0.75 V, 1.5 V	2.7		1.4				Ω
		I <sub>OUT</sub> = 100 mA, B <sub>0</sub> or B <sub>1</sub> = 0 V, 1 V, 2 V	4.5		0.2	0.3		0.4	
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = 0 V or V <sub>CC</sub> , I <sub>OUT</sub> = 0 V	3.6		0.1	0.5		1.0	μA
			5.5		0.1	0.5		1.0	
ΔI <sub>CC</sub>	Increase in I <sub>CC</sub> per Input	One Input at 2.7 V, others at V <sub>CC</sub> or GND (FSA4157A Only)	4.3		0.2			10.0	μA

3. Measured by the voltage drop between the 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).

4. ΔR<sub>ON</sub> = R<sub>ON max</sub> - R<sub>ON min</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.

# FSA4157, FSA4157A

## AC ELECTRICAL CHARACTERISTICS

(Typical values are at 25°C unless otherwise specified.)

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	Ambient Temperature					Unit	Figure
				-25°C			-40 to +85°C			
				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 (FSA4157A Only)	2.7 to 3.6			60		65	ns	Figure 8
		B <sub>0</sub> or B <sub>1</sub> = 1.5V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF	2.7 to 3.6			50		60		
		B <sub>0</sub> or B <sub>1</sub> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF	4.5 to 5.5			35		40		
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	2.7 to 3.6			20		30	ns	Figure 8
		B <sub>0</sub> or B <sub>1</sub> = 1.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF	4.5 to 5.5			15		20		
t <sub>BBM</sub>	Break-Before-Make Time	FSA4157	2.7 to 3.6						ns	Figure 9
			4.5 to 5.5		20					
		FSA4157A Only	4.5 to 5.5		25					
Q	Charge Injection	C <sub>L</sub> = 1.0 nF, V <sub>GE</sub> = 0 V, R <sub>GEN</sub> = 0 Ω	2.7 to 3.6		10				pC	Figure 11
			4.5 to 5.5		20					
OIRR	Off Isolation	f = 1 MHz, R <sub>L</sub> = 50 Ω	2.7 to 3.6		-70				dB	Figure 10
			4.5 to 5.5		-70					
Xtalk	Crosstalk	f = 1 MHz, R <sub>L</sub> = 50 Ω	2.7 to 3.6		-70				dB	Figure 10
			4.5 to 5.5		-70					
BW	-3db Bandwidth	R <sub>L</sub> = 50 Ω	2.7 to 3.6			300			MHz	Figure 13
			4.5 to 5.5			300				
THD	Total Harmon Distortion	R <sub>L</sub> = 600 Ω, V <sub>IN</sub> = 0.5, f = 20 Hz to 20 kHz	2.7 to 3.6		0.002				%	Figure 14
			4.5 to 5.5		0.002					

## CAPACITANCE

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	Ambient Temperature -25°C			Units	Figure
				Min.	Typ.	Max.		
C <sub>IN</sub>	Control Pin Input Capacitance	f = 1 MHz	0.0		3.5		pF	Figure 12
C <sub>OFF</sub>	B Port Off Capacitance	f = 1 MHz	4.5		12.0		pF	Figure 12
C <sub>ON</sub>	On Capacitance	f = 1 MHz	4.5		40.0		pF	Figure 12

# FSA4157, FSA4157A

## TYPICAL PERFORMANCE CHARACTERISTICS

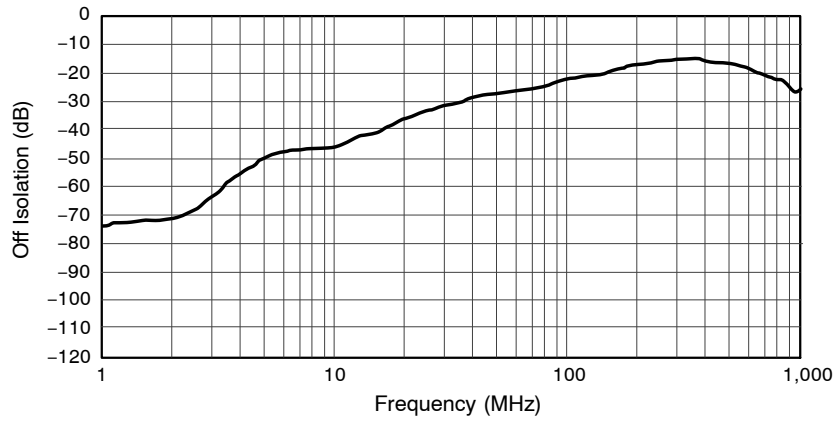


Figure 3. Off Isolation,  $V_{CC} = 2.7\text{ V to }5.5\text{ V}$

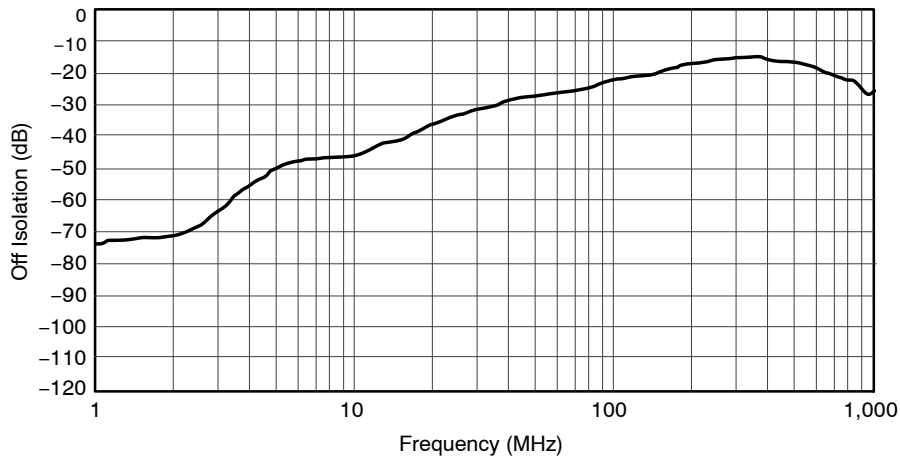


Figure 4. Crosstalk,  $V_{CC} = 2.7\text{ V to }5.5\text{ V}$

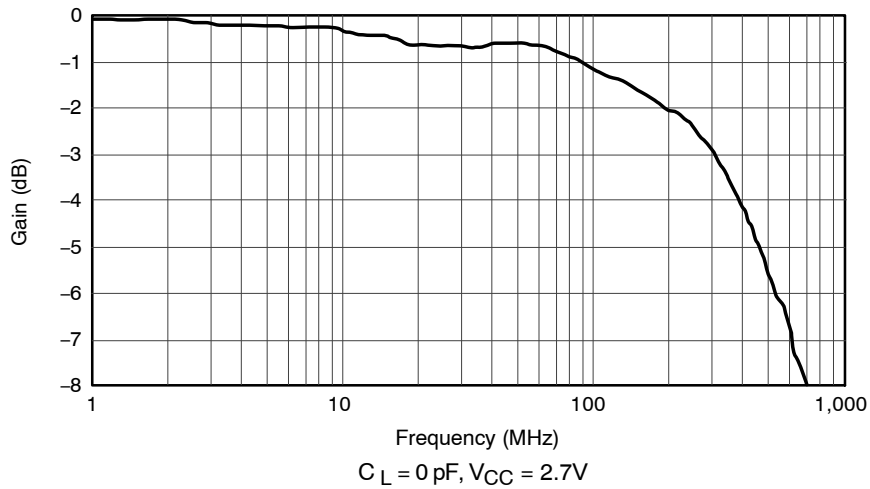


Figure 5. Crosstalk,  $V_{CC} = 2.7\text{ V to }5.5\text{ V}$

# FSA4157, FSA4157A

## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

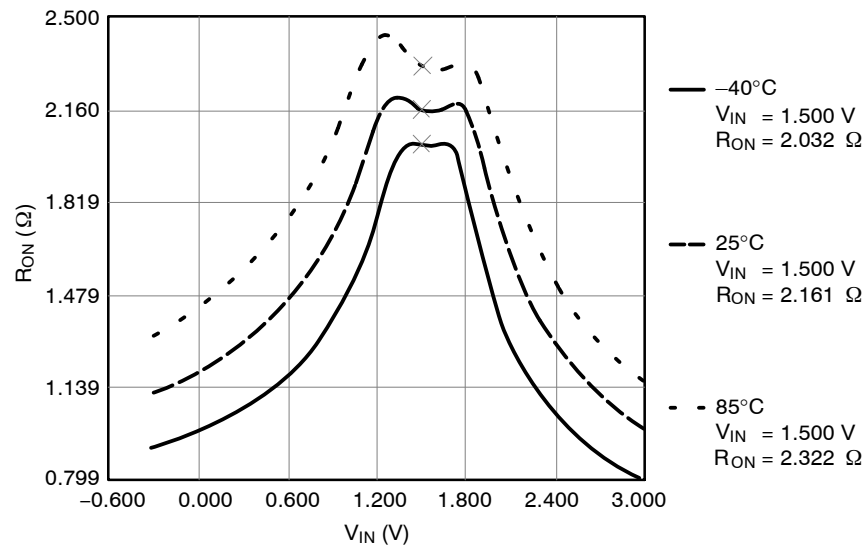


Figure 6.  $R_{ON}$  Switch On Resistance,  $I_{ON} = 100$  mA,  $V_{CC} = 2.7$  V

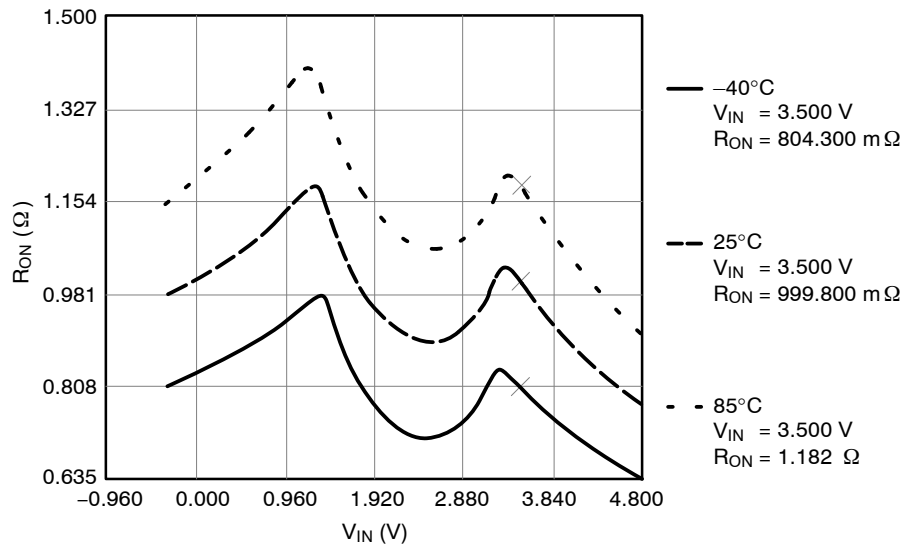
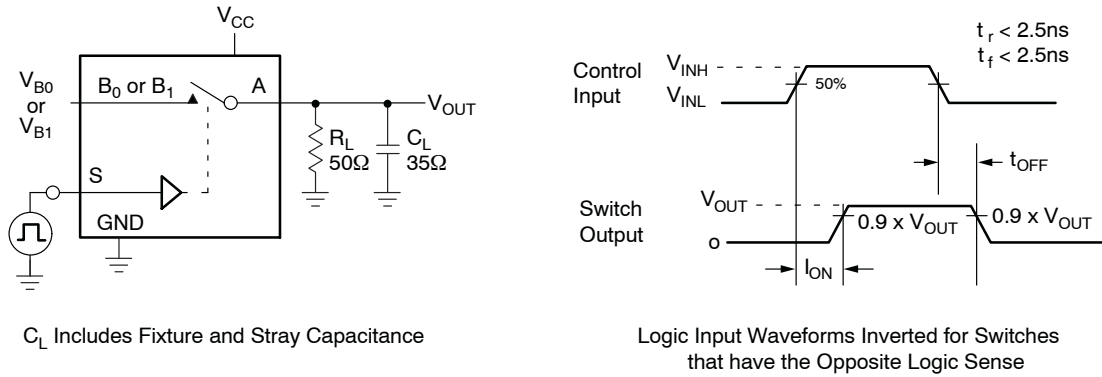


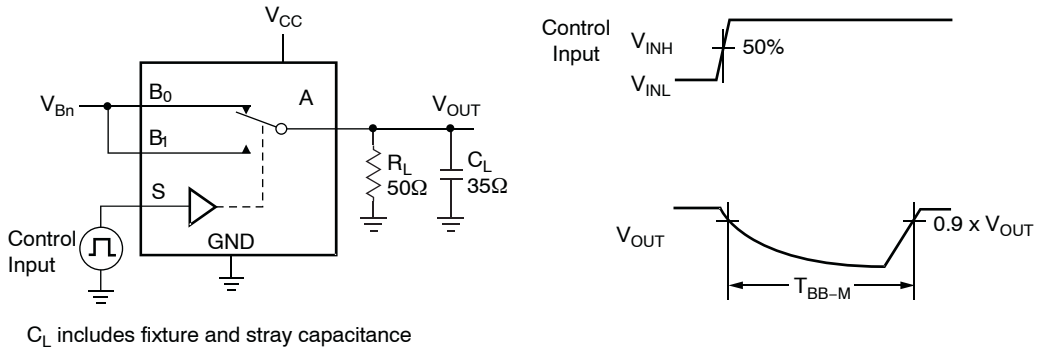
Figure 7.  $R_{ON}$  Switch On Resistance,  $I_{ON} = 100$  mA,  $V_{CC} = 4.5$  V

# FSA4157, FSA4157A

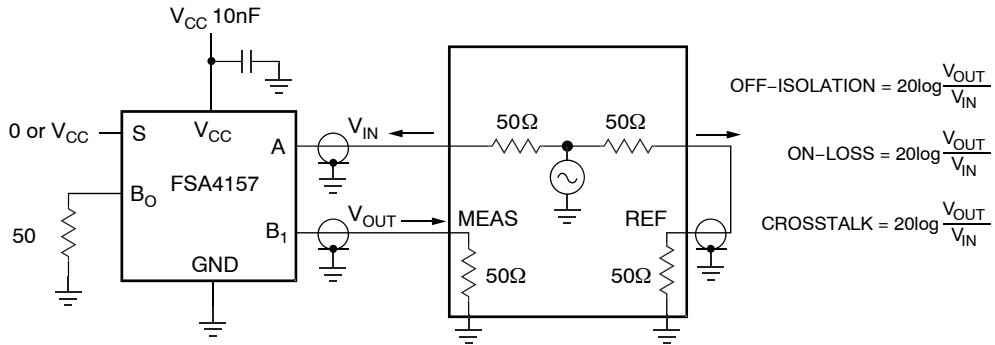
## AC LOADINGS AND WAVEFORMS



**Figure 8. Turn On / Off Timing**



**Figure 9. Break Before Make Timing**



**Figure 10. Off Isolation and Crosstalk**



# FSA4157, FSA4157A

## AC LOADINGS AND WAVEFORMS (Continued)

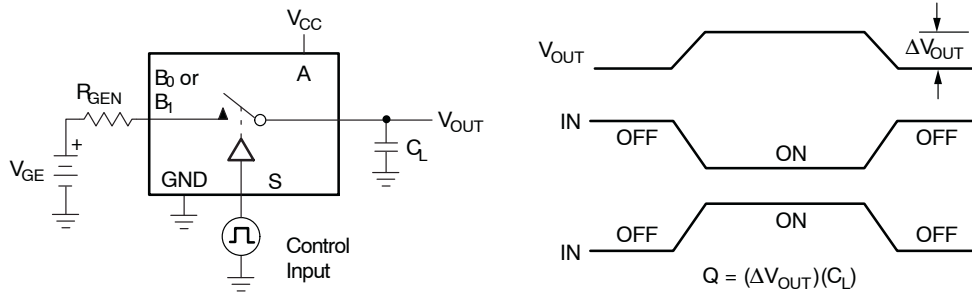


Figure 11. Charge Injection

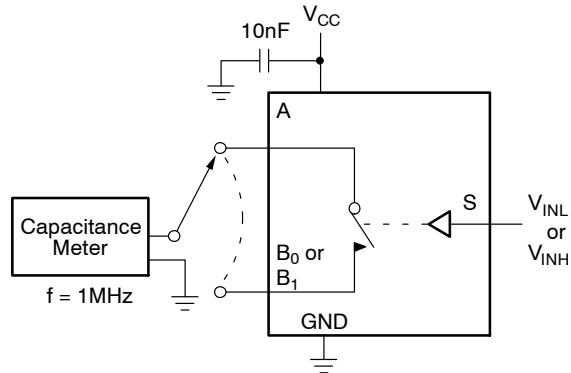


Figure 12. On / Off Capacitance Measurement Setup

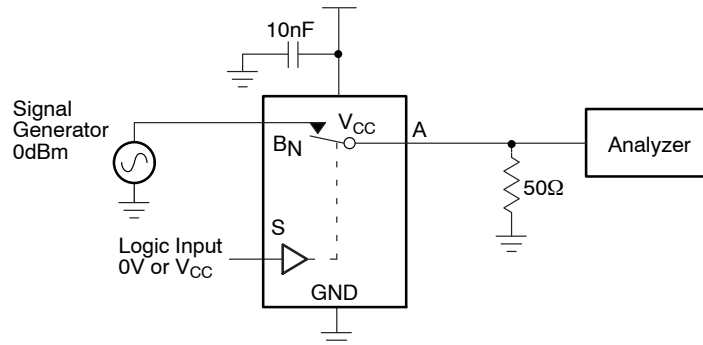


Figure 13. Bandwidth

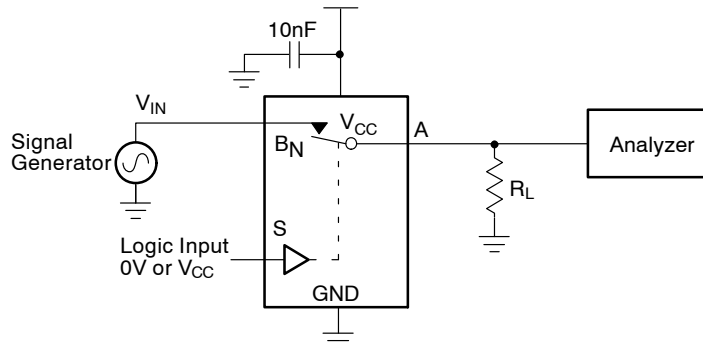
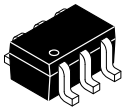


Figure 14. Harmonic Distortion

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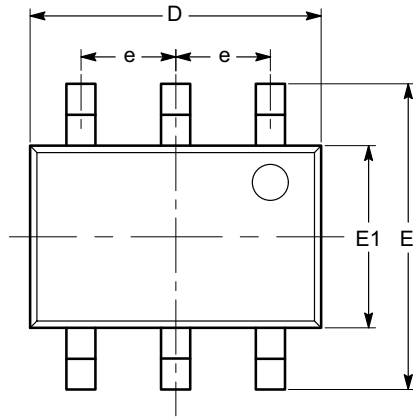
**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**



1

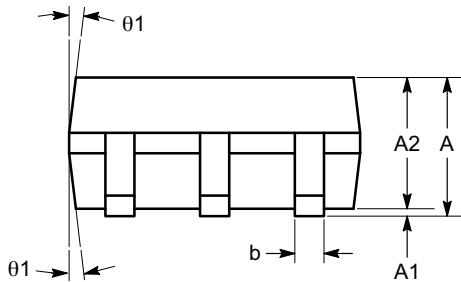
**SC-88 (SC-70 6 Lead), 1.25x2**  
**CASE 419AD**  
**ISSUE A**

DATE 07 JUL 2010

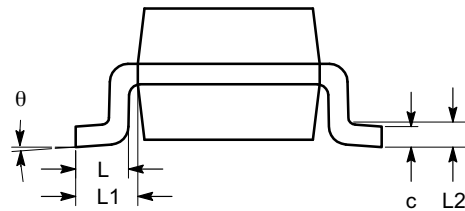


**TOP VIEW**

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		
$\theta$	0°		8°
$\theta_1$	4°		10°



**SIDE VIEW**



**END VIEW**

**Notes:**

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

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