Low-Voltage 0.4 Ω 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 Ω impedance, sub−μA 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 μA 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 μA under a worst−case condition of $V_{CC} = 4.3$ V and $V_{IN} = 1.8$ V.

Features

- Typical 0.4 Ω On Resistance (R_{ON}) for +2.7 V Supply
- FSA5157 Features Less than 12 μA I_{CCT} Current When S Input is Lower than V_{CC}
- 0.25 Ω 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 Ω Load)
- High−Current Handling Capability (350 mA Continuous Current under 3.3 V Supply)
- Control Logic is 1.8 V CMOS Logic Compatible
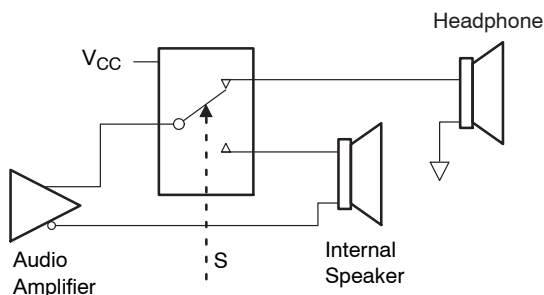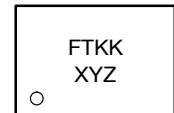- These Devices are Pb−Free and are RoHS Compliant

MARKING DIAGRAMS

SIP6 1.45 x 1.0
CASE 127EB

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FTKK
XYZ
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FT	= Specific Device Code
KK	= 2−Digits Lot Run Traceability Code
XY	= 2−Digit Date Code
Z	= Assembly Plant Code
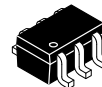
SC−88 / SC−70
6 Lead, 1.25 x 2
CASE 419AD

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C57M
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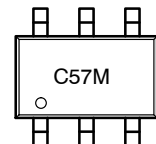
| C57 | = Specific Device Code |
| M | = Assembly Operation Month |

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

ORDERING INFORMATION

Applications

- Cellular Phone
- PDA
- Portable Media Player

APPLICATION DIAGRAM

Figure 1. Application Diagram

October, 2022 − Rev. 3

Publication Order Number:
FSA5157/D

FSA5157

PIN CONFIGURATIONS
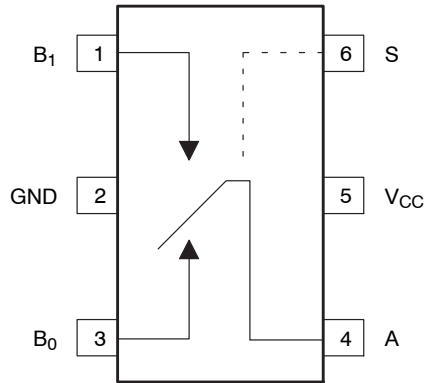
Figure 2. 6−Lead SC70
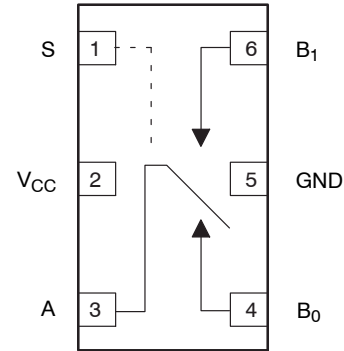
Figure 3. SIP6

PIN DEFINITIONS

Pin Names	Function
A, B_0, B_1	Data Ports
S	Control Input

TRUTH TABLE

Control Input (S)	Function
LOW Logic Level	B_0 Connected to A
HIGH Logic Level	B_1 Connected to A

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply Voltage	−0.5	5.5	V
V_S	Switch Voltage (Note 1)	−0.5	V_{CC} + 0.3 V	V
V_{IN}	Input Voltage (Note 1)	−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 1 ms Duration, < 10% Duty Cycle)		500	mA
P_D	SC70 6L Package		180	mW
	SIP6 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

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_{CC}	Supply Voltage	1.65	4.30	V
V_{IN}	Control Input Voltage (Note 2)	0	V_{CC}	V
V_{IN}	Switch Input Voltage	0	V_{CC}	V
T_A	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_{CC} (V)	T_A = +25°C			T_A = −40°C to +85°C		Unit
				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} = 0 V 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 = 0.3 V, V_{CC} −0.3 V, B_0 or B_1 = 0.3 V, V_{CC} −0.3 V or Floating	1.95 to 4.3	−10		10	−50	50	nA
$I_{A(ON)}$	On Leakage Current of Port A	A = 0.3 V, V_{CC} −0.3 V, B_0 or B_1 = 0.3 V, V_{CC} −0.3 V or Floating	1.95 to 4.3	−20		20	−100	100	nA
R_{ON}	Switch On Resistance (Note 3)	I_{OUT} = 100 mA, B_0 or B_1 = 0 V, 0.7 V, 3.6 V, 4.3 V	4.3		0.36			0.60	Ω
		I_{OUT} = 100 mA, B_0 or B_1 = 0 V, 0.7 V, 2.0 V, 2.7 V	2.7		0.4			0.70	
		I_{OUT} = 100 mA, B_0 or B_1 = 0 V, 0.7 V, 2.0 V, 2.3 V	2.3		0.55			0.80	
		I_{OUT} = 100 mA, B_0 or B_1 = 0.7 V	1.65		1.5	2.5		3.0	
ΔR_{ON}	On Resistance Matching Between Channels (Note 4)	I_{OUT} = 100 mA, B_0 or B_1 = 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				
$R_{FLAT(ON)}$	On Resistance Flatness (Note 5)	I_{OUT} = 100 mA, B_0 or B_1 = 0 V 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} = 0 V or V_{CC}, I_{OUT} = 0	4.3	−100	30	100	−500	500	nA
I_{CCT}	Increase in I_{CC} per Control Input	V_{IN} = 1.8 V	4.3		7.0	12.0		15.0	μA
		V_{IN} = 2.6 V	4.3		3.0	6.0		7.0	

3. On resistance is determined by the voltage drop between the A an B pins at the indicated current through the switch.
4. ΔR_{ON} = R_{ONmax} − R_{ONmin} measured at identical V_{CC}, 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.

AC ELECTRICAL CHARACTERISTICS (All Typical values are at 25°C unless otherwise specified.)

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = +25°C			T_A = −40°C to +85°C		Unit	Figure
				Min	Typ	Max	Min	Max		
t_{ON}	Turn−On Time	B_0 or B_1 = 1.5 V, R_L = 50 Ω, C_L = 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_{OFF}	Turn−Off Time	B_0 or B_1 = 1.5 V, R_L = 50 Ω, C_L = 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_{BBM}	Break−Before−Make Time	B_0 or B_1 = 1.5 V, R_L = 50 Ω, C_L = 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_L = 1.0 nF, V_{GEN} = 0 V, R_{GEN} = 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_L = 50 Ω, C_L = 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_L = 50 Ω, C_L = 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_L = 50 Ω	1.65 to 4.3		80				MHz	Figure 13
THD	Total Harmonic Distortion		3.6 to 4.3						%	Figure 14
		R_L = 32 Ω, V_{IN} = 2V_{PP}, f = 20 Hz to 20 kHz	2.7 to 3.6		0.02					
		R_L = 32 Ω, V_{IN} = 1.5V_{PP}, f = 20 Hz to 20 kHz	2.3 to 2.7		0.036					
		R_L = 32 Ω, V_{IN} = 1.2V_{PP}, f = 20 Hz to 20 kHz	1.65 to 1.95		0.01					

CAPACITANCE

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = +25°C			T_A = −40°C to +85°C		Unit	Figure
				Min	Typ	Max	Min	Max		
C_{IN}	Control Pin Input Capacitance	f = 1 MHz	0.0		1.5				pF	Figure 12
C_{OFF}	B Port OFF Capacitance	f = 1 MHz	4.5		21.0				pF	Figure 12
C_{ON}	A Port ON Capacitance	f = 1 MHz	4.5		90.0				pF	Figure 12

FSA5157

TYPICAL CHARACTERISTICS
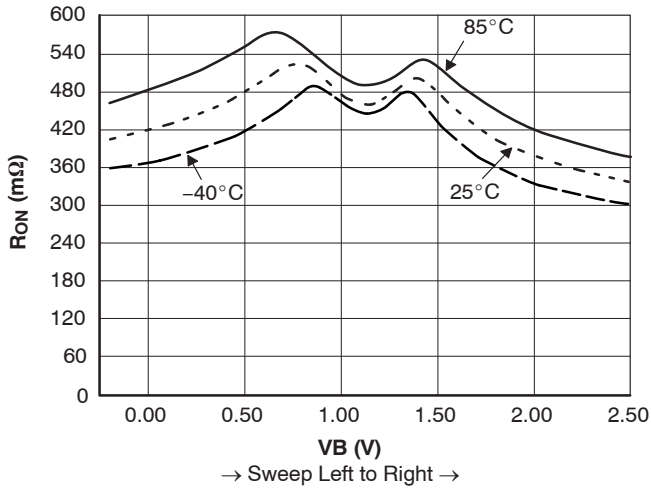
Figure 4. R$_{ON}$ Switch On Resistance,
I$_{ON}$ = 100 mA, V$_{CC}$ = 2.3 V B0
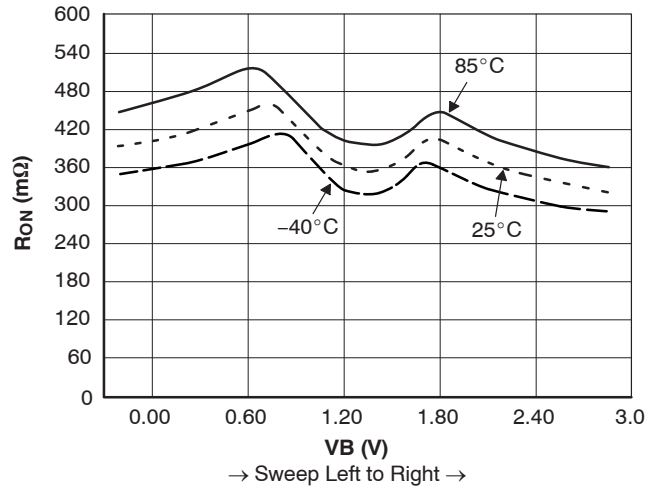
Figure 6. R$_{ON}$ Switch On Resistance,
I$_{ON}$ = 100 mA, V$_{CC}$ = 2.7 V B0
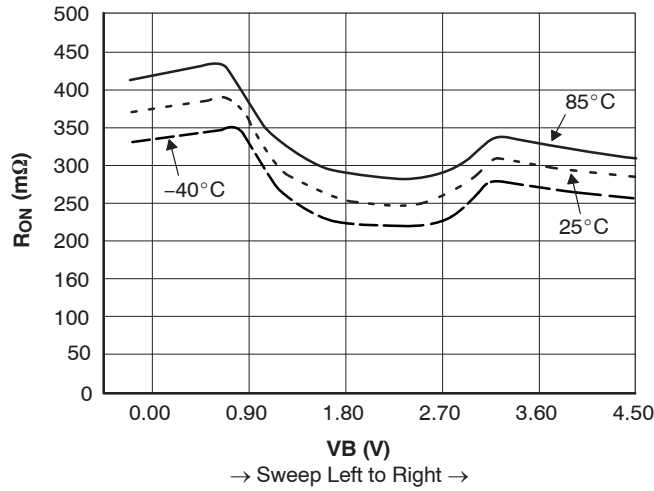
Figure 5. R$_{ON}$ Switch On Resistance,
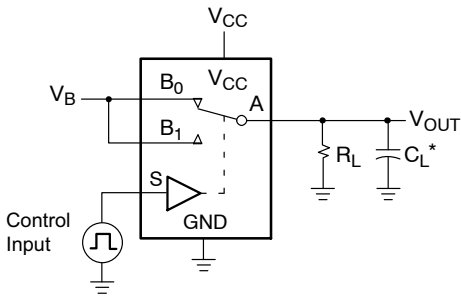I$_{ON}$ = 100 mA, V$_{CC}$ = 4.3 V B0

AC LOADINGS AND WAVEFORMS
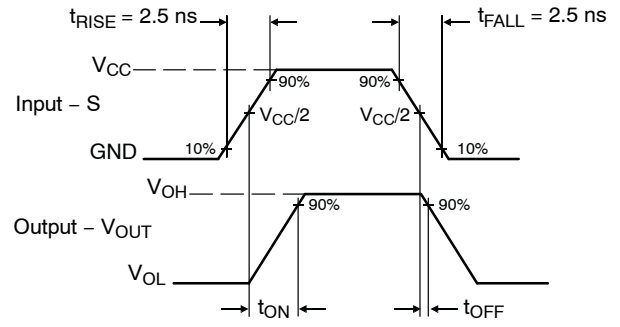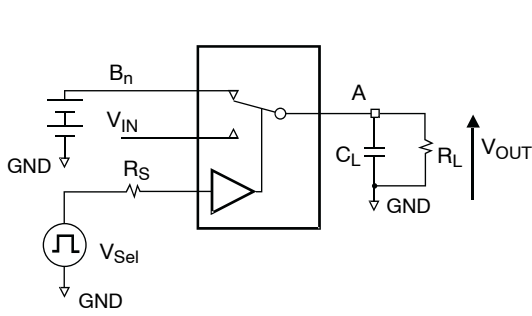
NOTES:

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
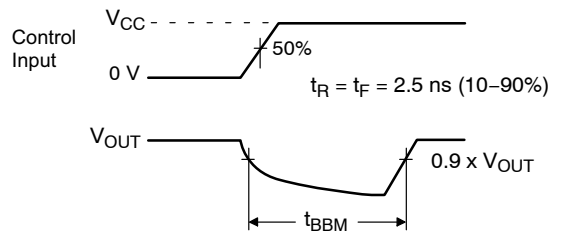
*C_L includes test fixture and stray capacitance.

Figure 8. Break−Before−Make Timing

Off−Isolation = 20 Log (V_{OUT}/V_{IN})
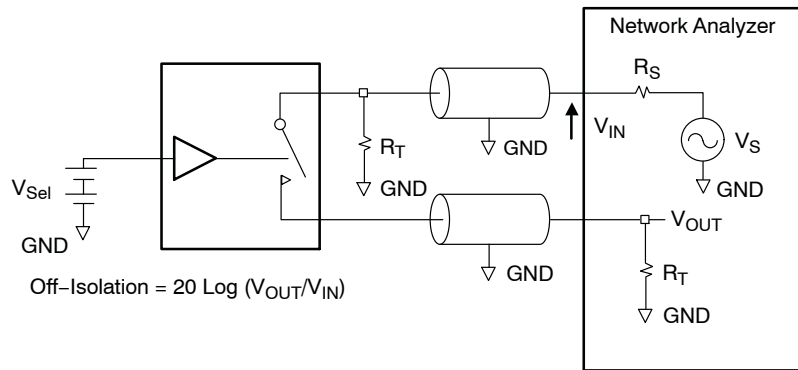
Figure 9. Off Isolation

AC LOADINGS AND WAVEFORMS (Continued)

Crosstalk = 20 Log (V_{OUT}/V_{IN})

RS and RT are functions of the application environment (50, 75, or 100).
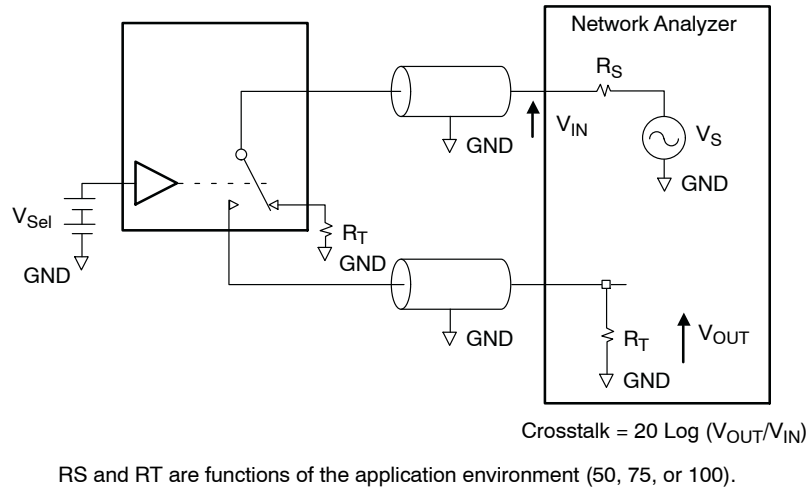
Figure 10. Non−Adjacent Channel−to−Channel Crosstalk

*C_L includes fixture and stray capacitance.

Q = ΔV_{OUT} x C_L
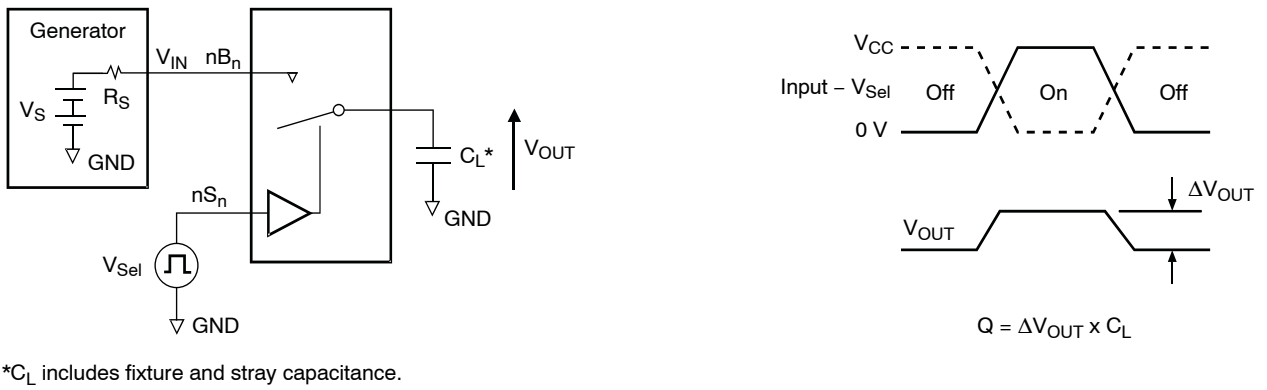
Figure 11. Charge Injection Test

Channel On Capacitance

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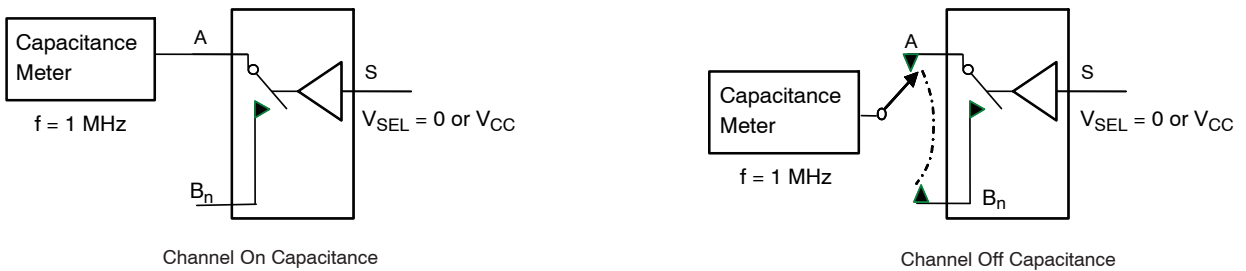
Figure 12. On/Off Capacitance Measurement Setup

AC LOADINGS AND WAVEFORMS (Continued)
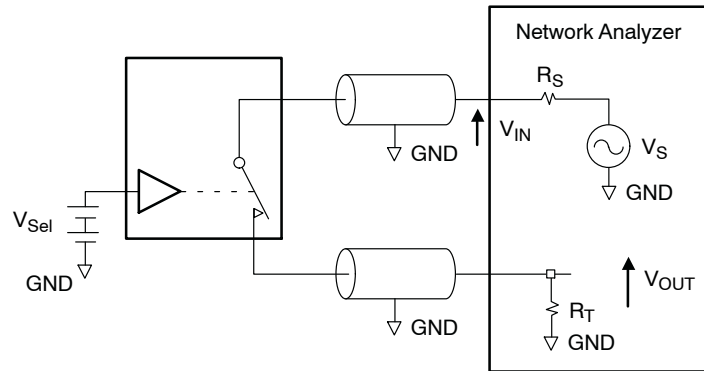
Figure 13. Bandwidth
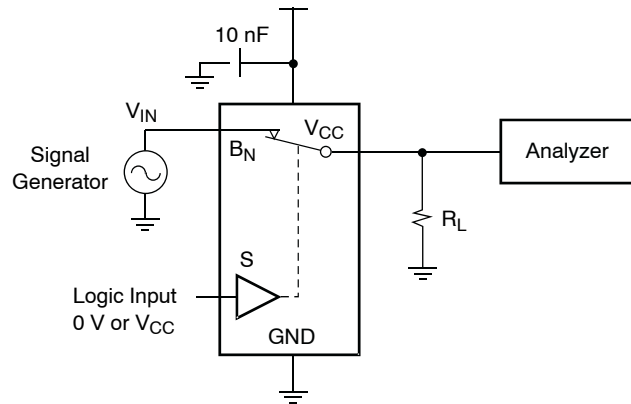
Figure 14. Harmonic Distortion

ORDERING INFORMATION

Part Number	Top Mark	Package	Shipping†
FSA5157P6X	C57	SC−88/SC−70 6 Lead, 1.25 x 2 (Pb−Free)	3000 / Tape & Reel
FSA5157L6X	FT	SIP6 1.45 x 1.0 (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.

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

SIP6 1.45X1.0
CASE 127EB
ISSUE O

DATE 31 AUG 2016

TOP VIEW

PIN 1 IDENTIFIER

RECOMMENED
LAND PATTERN

PIN 1

BOTTOM VIEW

DETAIL A

DETAIL A
PIN 1 TERMINAL

0.075 X 45° CHAMFER
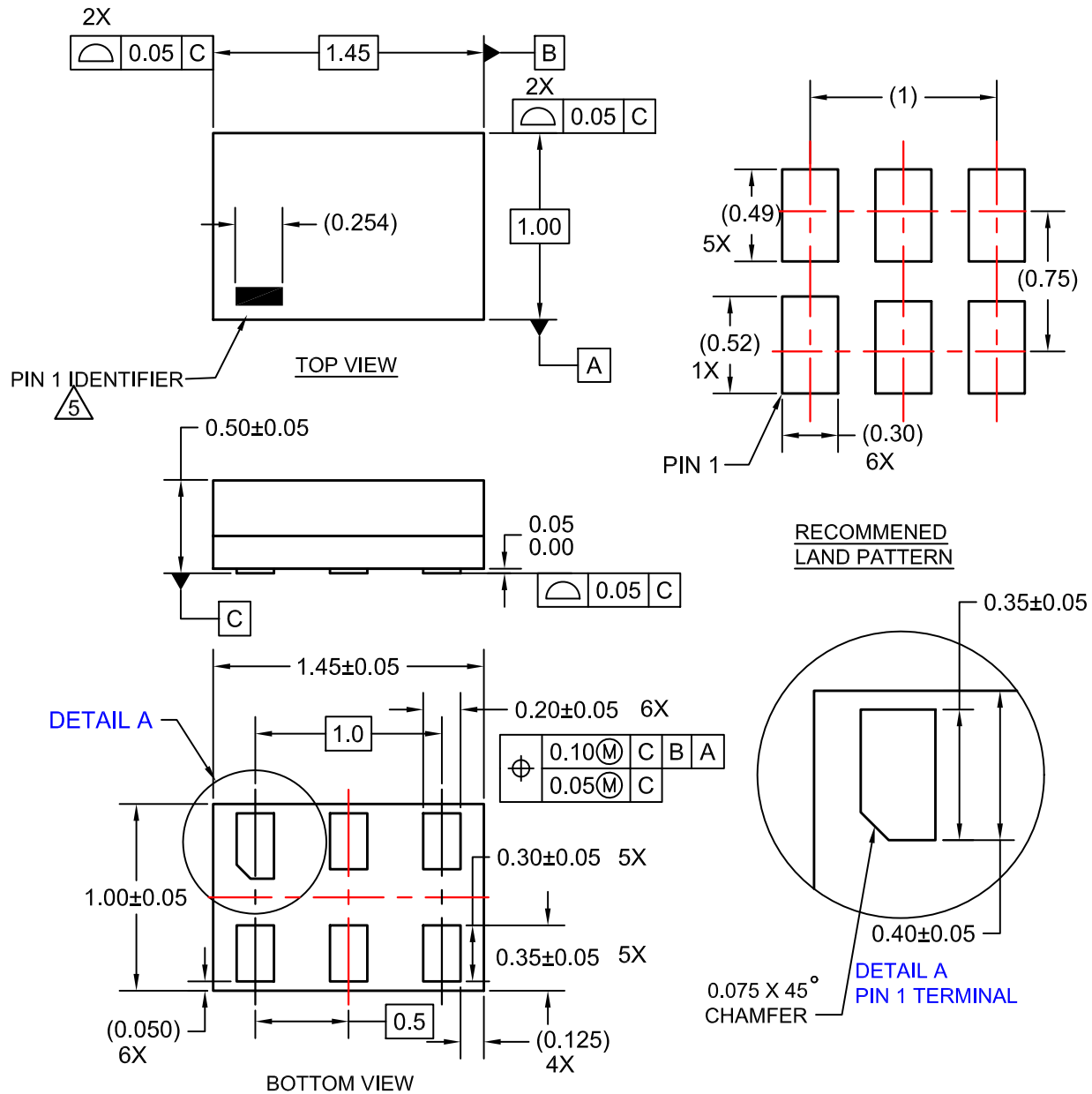
NOTES:

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.

DOCUMENT NUMBER:	98AON13590G	
DESCRIPTION:	SIP6 1.45X1.0	PAGE 1 OF 1

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

DATE 07 JUL 2010

1

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	0º		8º
θ1	4º		10º

TOP VIEW

SIDE VIEW

END VIEW

Notes:

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

DOCUMENT NUMBER:	98AON34266E	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.	
DESCRIPTION:	SC−88 (SC−70 6 LEAD), 1.25X2		PAGE 1 OF 1

PUBLICATION ORDERING INFORMATION

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