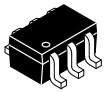
Low-Voltage, 1 Ω SPDT Analog Switch with Power-Off Isolation

FSA4159



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



SIP6 1.45X1.0
CASE 127EB

Description

The FSA4159 is a high−performance Single−Pole / Double−Throw (SPDT) analog switch. The device features ultra−low R_{ON} of 1 Ω at 4.5 V V_{CC} and operates over the wide V_{CC} range of 1.65 V to 5.50 V. The device is fabricated with sub−micron CMOS technology to achieve fast switching speeds and is designed for break−before−make operation.

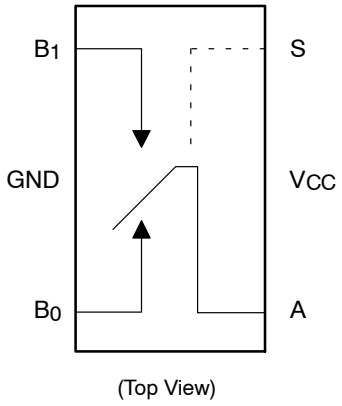
The FSA4159 features very low quiescent current even when the control voltage is lower than the V_{CC} supply. This feature services mobile handset applications by allowing direct interface with baseband processor general−purpose I/Os.

Features

- Low I_{CC} when the S Input is Lower than V_{CC}
- Power−Off Isolation (V_{CC} = 0 V)
- 1 Ω On Resistance (R_{ON}) at 4.5 V V_{CC}
- 0.25 Ω Maximum R_{ON} Flatness for 4.5 V V_{CC}
- Space−Saving, Pb−Free, 6−Lead SC70 Surface Mount Package
- Broad V_{CC} Operating Range: 1.65 V to 5.50 V
- Fast Turn−On and Turn−Off Times
- Break−Before−Make Enable Circuitry
- These Devices are Pb−Free and are RoHS Compliant

Applications

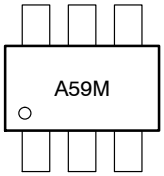
- Cellular Phone
- Portable Media Player
- PDA



(Top View)

Figure 1. Analog Symbols

MARKING DIAGRAMS



A59 = Specific Device Code
M = Assembly Operationmonth



FX = Specific Device Code (S2)
&K = 2−Digits Lot Run Traceability Code
&2 = 2−Digit Date Code
&Z = Assembly Plant Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

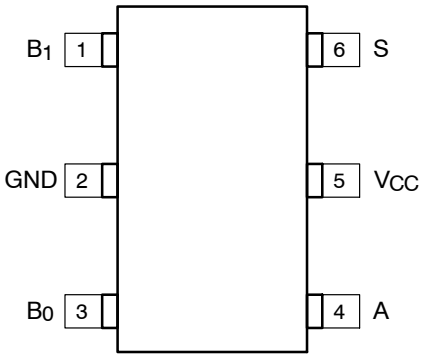
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ORDERING INFORMATION

Part Number	Operating Temperature Range	Top Mark	Package	Shipping†
FSA4159P6X	−40°C to +85°C	A59	SC−88 (SC−70 6 Lead), 1.25x2 (Pb−Free)	3000 / Tape & Reel
FSA4159L6X	−40°C to +85°C	S2	SIP6 1.45X1.0 (Pb−Free)	5000 / Tape & Reel

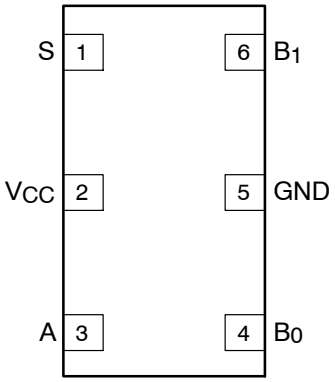
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

PIN CONFIGURATION



(Top View)

Figure 2. SC70 Pin Assignments



(Top Through View)

Figure 3. 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_{CC}	Supply Voltage
6	1	S	Control Input

TRUTH TABLE

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Min	Max	Unit
V_{CC}	Supply Voltage		−0.5	6.5	V
V_{SW}	Switch Voltage (Note 1)		−0.5	V_{CC} + 0.5	V
V_{IN}	Input Voltage (Note 1)		−0.5	6.5	V
I_{IK}	Input Diode Current			−50	mA
I_{SW}	Switch Current (Continuous)			200	mA
I_{SWPEAK}	Peak Switch Current (Pulsed at 1 ms Duration, < 10% Duty Cycle)			400	mA
P_D	Power Dissipation at 85°C			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	Electrostatic Discharge Capability	Human Body Model (JEDEC: JESD22−A114)		4000	V
		Charged Device Model (JEDEC: JESD22−C101)		1500	
		Machine Model (JEDEC: JESD22−A115)		200	

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 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	5.50	V
S	Control Input Voltage (Note 2)	0	V_{CC}	V
V_{SW}	Switch Input Voltage	0	V_{CC}	V
T_A	Operating Temperature	−40	+85	°C
θ_{JA}	Thermal Resistance, Still Air		350	°C/W

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; it must not float.

DC ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter	V_{CC}(V)	Conditions	Ambient Temperature (T_A)					Unit
				25°C			−40 to +85°C		
				Min.	Typ.	Max.	Min.	Max.	
V_{IH}	Input Voltage High	4.50 to 5.50					2.4		V
		3.00 to 3.60					2.4		
		2.30 to 2.70					1.8		
		1.65 to 1.95					1.5		
V_{IL}	Input Voltage Low	4.50 to 5.50						0.8	V
		3.00 to 3.60						0.8	
		2.30 to 2.70						0.6	
		1.65 to 1.95						0.6	
I_{IN}	Control Input Leakage	5.50	V_{IN} = 0 V or V_{CC}	−2		2	−100	100	nA
		3.60		−2		2	−100	100	
		2.70		−2		2	−20	20	
		1.95		−2		2	−20	20	
$I_{NO(OFF)}$, $I_{NC(OFF)}$	Off Leakage Current of Port B_0 and B_1	5.50	A = 1 V, 4.5 V, B_0 or B_1 = 4.5 V, 1.0 V	−10		10	−50	50	nA
		3.60	A = 1 V, 3.0 V, B_0 or B_1 = 3.0 V, 1.0 V	−10		10	−50	50	
		2.70	A = 0.5 V, 2.3 V, B_0 or B_1 = 2.3 V, 0.5 V	−10		10	−50	50	
		1.95	A = 0.3 V, 1.65 V, B_0 or B_1 = 1.65 V, 0.3 V	−5		5	−20	20	
$I_{NO(ON)}$, $I_{NC(ON)}$	On Leakage Current of Port B_0 and B_1	5.50	A = Float, B_0 or B_1 = 4.5 V, 1.0 V	−20		20	−100	100	nA
		3.60	A = Float, B_0 or B_1 = 3.0 V, 1.0 V	−10		10	−20	20	
		2.70	A = Float, B_0 or B_1 = 2.3 V, 0.5 V	−10		10	−20	20	
		1.95	A = Float, B_0 or B_1 = 1.65 V, 0.3 V	−5		5	−20	20	
$I_{A(ON)}$	On Leakage Current of Port A	5.50	A = 1 V, 4.5 V B_0 or B_1 = 1 V, 4.5 V, or Floating	−20		20	−100	100	nA
		3.60	A = 1 V, 3 V B_0 or B_1 = 1 V, 3 V, or Floating	−10		10	−20	20	
		2.70	A = 0.5 V, 2.3 V B_0 or B_1 = 0.5 V, 2.3 V, or Floating	−10		10	−20	20	
		1.95	A = 0.3 V, 1.65 V B_0 or B_1 = 0.3 V, 1.65 V, or Floating	−5		5	−20	20	
I_{OFF}	Power Off Leakage Current of Port A & Port B	0	A = 0 to 5.5 V B_0 or B_1 = 0 to 5.5 V		±1.00		−5.00	5.00	μA

DC ELECTRICAL CHARACTERISTICS (continued)
(All typical values are at 25°C unless otherwise specified.)

Symbol	Parameter	V_{CC}(V)	Conditions	Ambient Temperature (T_A)					Unit
				25°C			−40 to +85°C		
				Min.	Typ.	Max.	Min.	Max.	
R_{PEAK}	Peak On Resistance	4.50	I_{OUT} = −100 mA, B_0 or B_1 = 0 to V_{CC}		1.0	1.1		1.3	Ω
		3.00	I_{OUT} = −100 mA, B_0 or B_1 = 0 to V_{CC}		1.2	1.5		1.8	
		2.30	I_{OUT} = −8 mA, B_0 or B_1 = 0 to V_{CC}		1.5	2.0		2.5	
		1.65	I_{OUT} = 2 mA, B_0 or B_1 = 0 to V_{CC} T_A = 25, 85°C		4.0	10.0		15.0	
			I_{OUT} = 2 mA, B_0 or B_1 = 0 to V_{CC} T_A = −40°C		10.0				
R_{ON}	Switch On Resistance (Note 3)	4.50	I_{OUT} = −100 mA, B_0 or B_1 = 2.5 V		0.8	0.9		1.1	Ω
		3.00	I_{OUT} = −100 mA, B_0 or B_1 = 2.0 V		1.0	1.3		1.6	
		2.30	I_{OUT} = −8 mA, B_0 or B_1 = 1.8 V		1.4	2.0		2.4	
		1.65	I_{OUT} = −2 mA, B_0 or B_1 = 1.5 V		1.7	2.5		3.5	
ΔR_{ON}	On Resistance Matching Between Channels (Note 4)	4.50	I_{OUT} = −100 mA, B_0 or B_1 = 2.5 V		0.05	0.10		0.10	Ω
		3.00	I_{OUT} = −100 mA, B_0 or B_1 = 2.0 V		0.10	0.15		0.15	
		2.30	I_{OUT} = −8 mA, B_0 or B_1 = 1.8 V		0.15	0.20		0.20	
		1.65	I_{OUT} = −2 mA, B_0 or B_1 = 1.5 V		0.15	0.40		0.40	
$R_{FLAT(ON)}$	On Resistance Flatness (Note 5)	4.50	I_{OUT} = −100 mA, B_0 or B_1 = 1.0 V, 1.5 V, 2.5 V		0.075	0.250		0.250	Ω
		3.00	I_{OUT} = −100 mA, B_0 or B_1 = 0.8 V, 2.0 V		0.1	0.3		0.3	
		2.30	I_{OUT} = −8 mA, B_0 or B_1 = 0.8 V, 1.8 V		0.2	1.0		1.0	
		1.65	I_{OUT} = −2 mA, B_0 or B_1 = 0.6 V, 1.5 V		3.5				
I_{CC}	Quiescent Supply Current	5.50	V_{IN} = 0 or V_{CC}, I_{OUT} = 0		10.0	50.0		500.0	nA
		3.60	V_{IN} = 0 or V_{CC}, I_{OUT} = 0		1.0	25.0		100.0	
		2.70	V_{IN} = 0 or V_{CC}, I_{OUT} = 0		0.5	20.0		50.0	
		1.95	V_{IN} = 0 or V_{CC}, I_{OUT} = 0		0.5	15.0		50.0	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. On resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.
4. $\Delta R_{ON} = R_{ON\ max} - R_{ON\ min}$ 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 V_{CC} = 1.8 V, 2.5 V, 3.0 V, 5.0 V at 25°C unless otherwise specified.)

Symbol	Parameter	V_{CC}(V)	Conditions	Ambient Temperature (T_A)					Unit	Figure
				25°C			−40 to +85°C			
				Min.	Typ.	Max.	Min.	Max.		
tON	Turn−On Time	4.50 to 5.50	B_0 or B_1 = V_{CC}, R_L = 50 Ω, C_L = 35 pF	1	16	30	1	35	ns	Figure 11
		3.00 to 3.60		5	21	35	3	50		
		2.30 to 2.70		5	28	40	5	50		
		1.65 to 1.95		10	50	70	10	75		
tOFF	Turn−Off Time	4.50 to 5.50	B_0 or B_1 = V_{CC}, R_L = 50 Ω, C_L = 35 pF	1	13	20	1	30	ns	Figure 11
		3.00 to 3.60		1	15	20	1	30		
		2.30 to 2.70		2	20	35	2	50		
		1.65 to 1.95		2.0	28	40	2	50		
tBBM	Break−Before−Make Time	4.50 to 5.50	B_0 or B_1 = V_{CC}, R_L = 50 Ω, C_L = 35 pF		3.0		0.1	20.0	ns	Figure 12
		3.00 to 3.60			6.0		1.0	40.0		
		2.30 to 2.70		2.0	10.0	35.0	2.0	45.0		
		1.65 to 1.95			22.0		2.0	70.0		
Q	Charge Injection	5.50	C_L = 1.0 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω		15				pC	Figure 14
		3.30			11					
		2.50			8					
		1.65			6					
OIRR	Off Isolation	1.80 to 5.00	f = 1 MHz, R_L = 50 Ω		−60				dB	Figure 13
Xtalk	Crosstalk	1.80 to 5.00	f = 1 MHz, R_L = 50 Ω		−60				dB	Figure 13
BW	−3db Bandwidth	5.50	R_L = 50 Ω		180				MHz	Figure 7 Figure 8 Figure 16
		3.30			180					
		2.50			180					
		1.65			180					
THD	Total Harmonic Distortion	1.80	R_L = 600 Ω, V_{IN} = 0.5 V_{PP}, f = 20 Hz to 20 kHz		0.006				%	Figure 10 Figure 17
		5.00			0.002					

CAPACITANCE

Symbol	Parameter	V_{CC} (V)	Conditions	T_A = 25°C			Unit	Figure
				Min.	Typ.	Max.		
C_{IN}	Control Pin Input Capacitance	0	f = 1 MHz		3.5		pF	Figure 10
C_{OFF}	B Port Off Capacitance	1.65 to 5.50	f = 1 MHz		12.0		pF	Figure 10
C_{ON}	A Port On Capacitance	1.65 to 5.50	f = 1 MHz		40.0		pF	Figure 10

TYPICAL PERFORMANCE CHARACTERISTICS

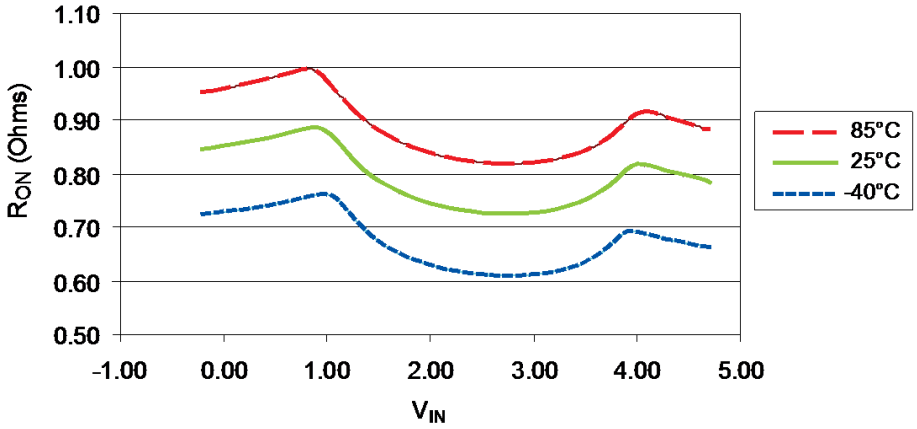


Figure 4. Switch R_{ON} (V_{CC} = 4.5 V)

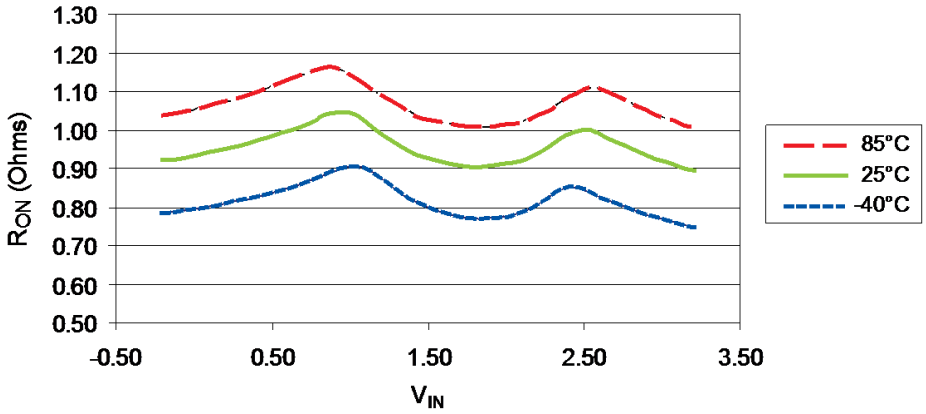


Figure 5. Switch R_{ON} (V_{CC} = 3.0 V)

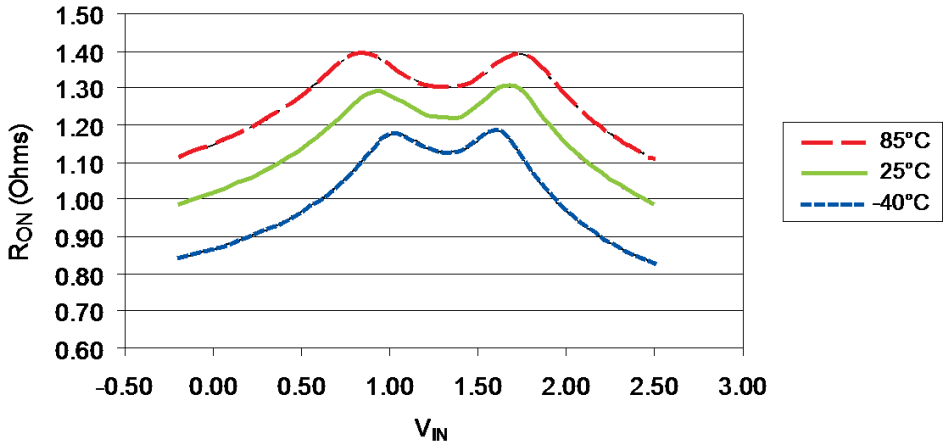


Figure 6. Switch R_{ON} (V_{CC} = 2.3 V)

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

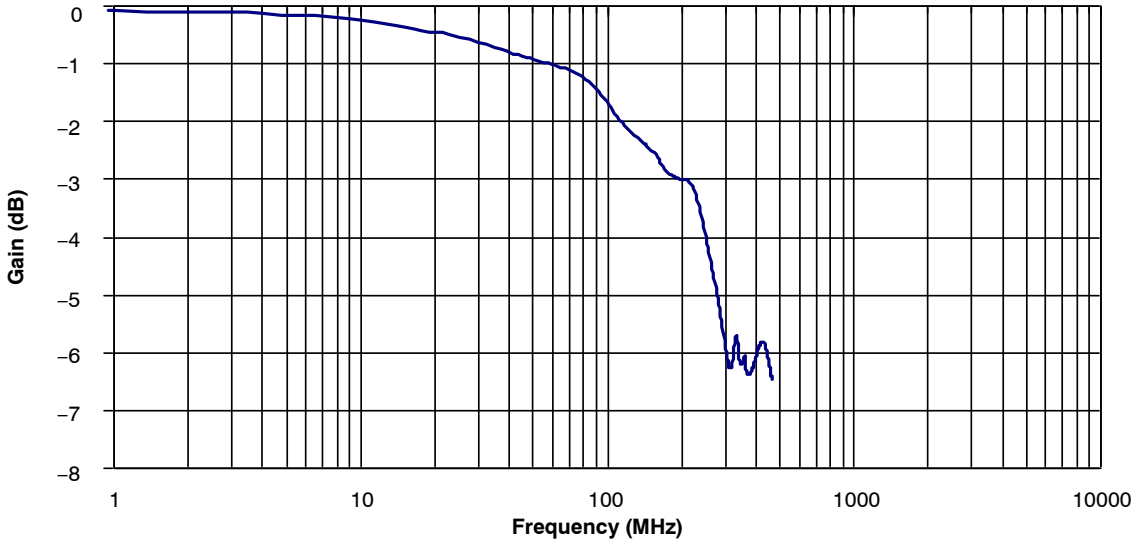


Figure 7. Frequency Response (C_L = 0 pF, V_{CC} = 5.5 V)

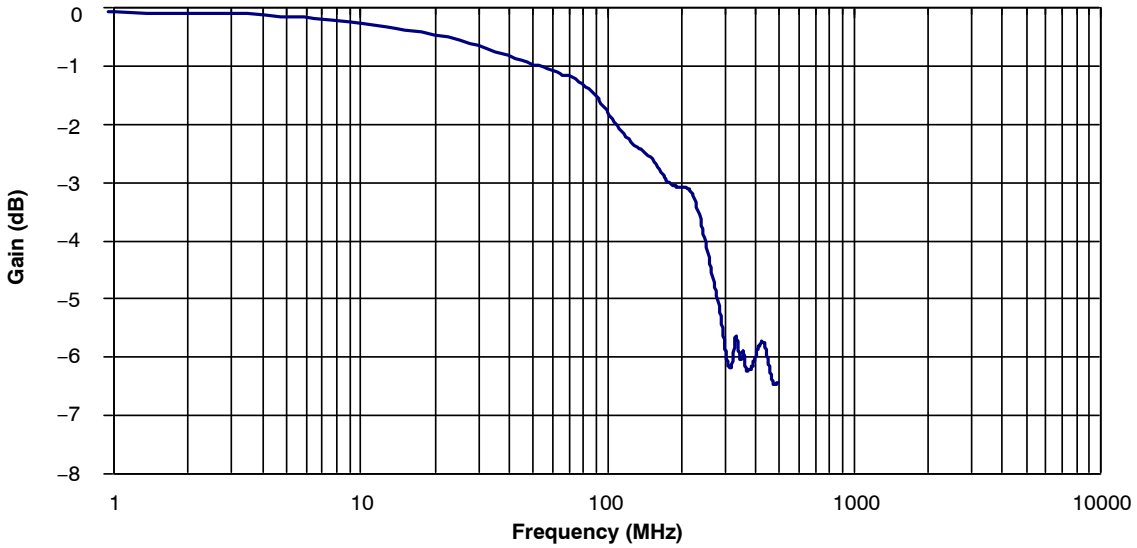


Figure 8. Frequency Response (C_L = 0 pF, V_{CC} = 3.3 V)

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

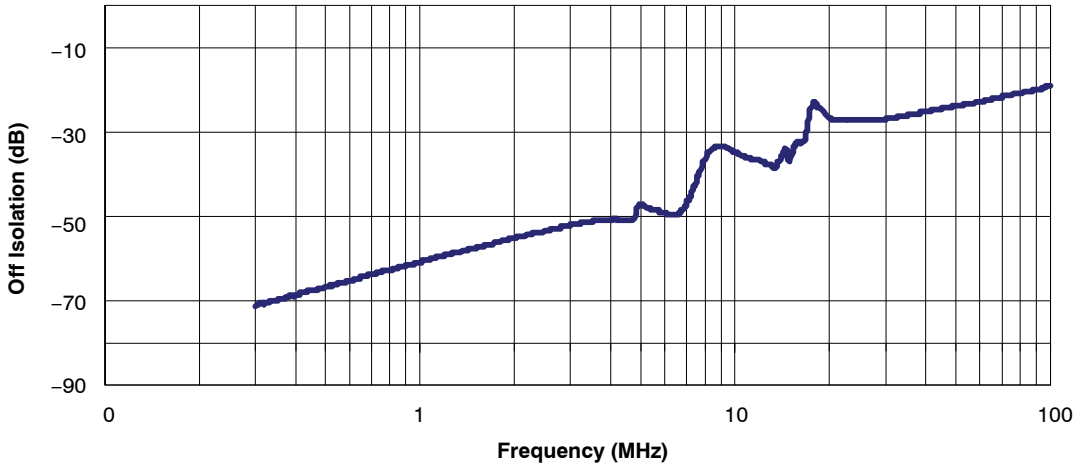


Figure 9. Off Isolation (V_{CC} = 5.0 V)

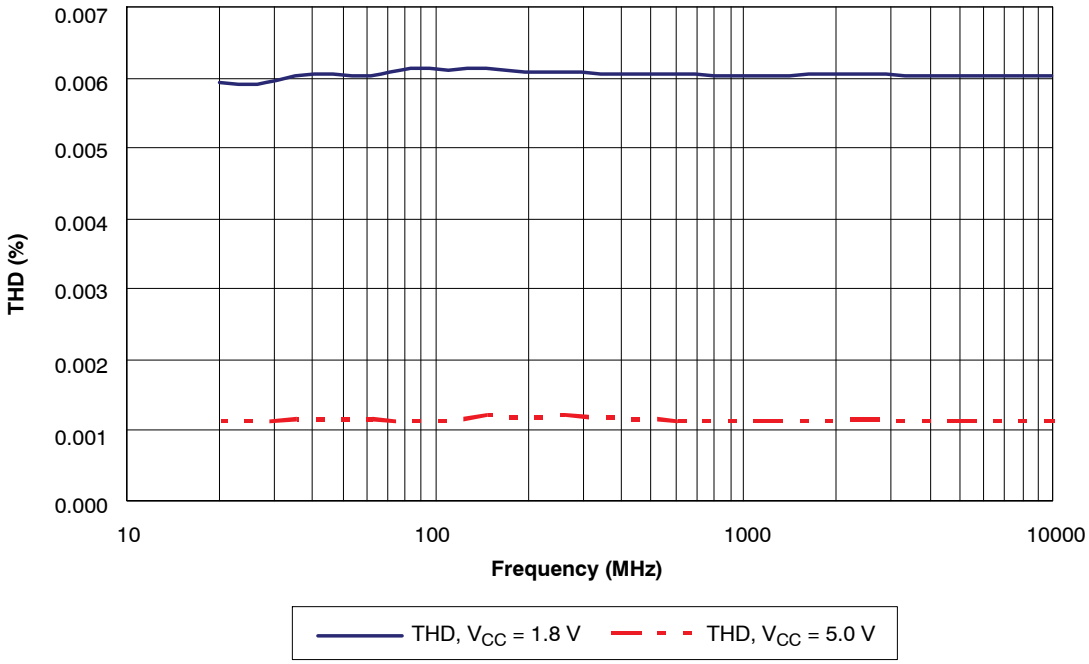
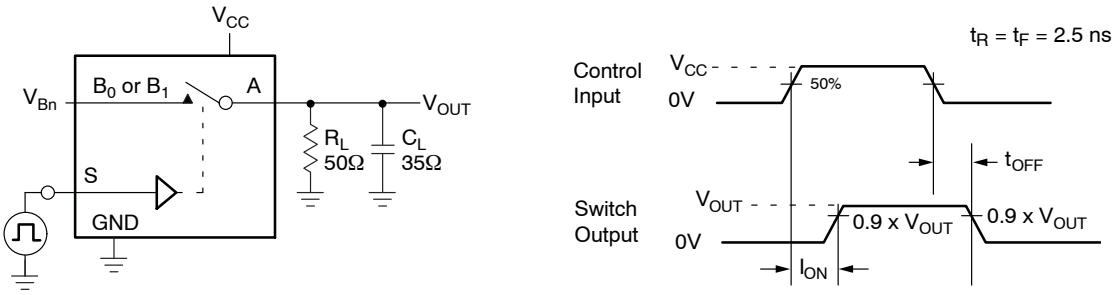


Figure 10. Total Harmonic Distortion, Frequency Response (C_L = 0 pF)

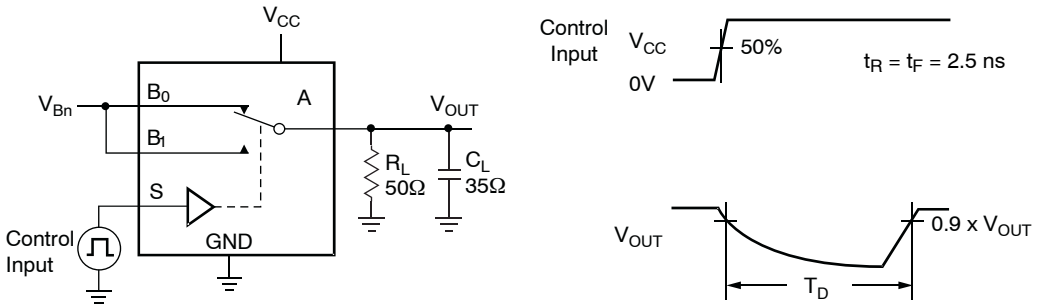
TEST DIAGRAMS



C_L Includes Fixture and Stray Capacitance

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

Figure 11. Turn On / Off Timing



C_L includes fixture and stray capacitance

Figure 12. Break−Before−Make Timing

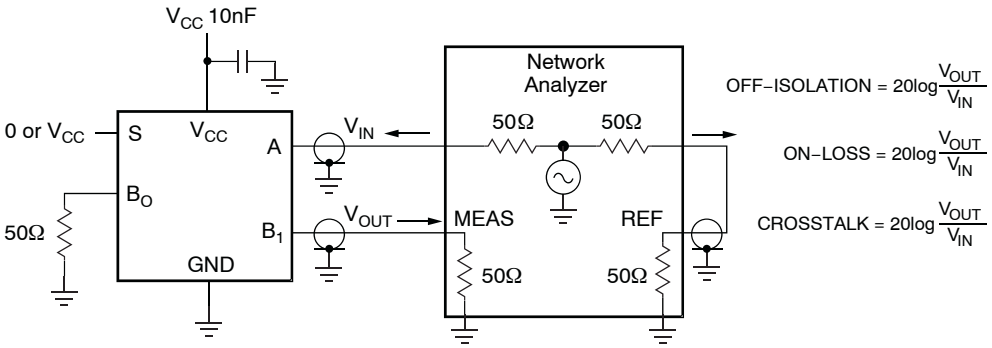


Figure 13. Off Isolation and Crosstalk

TEST DIAGRAMS (Continued)

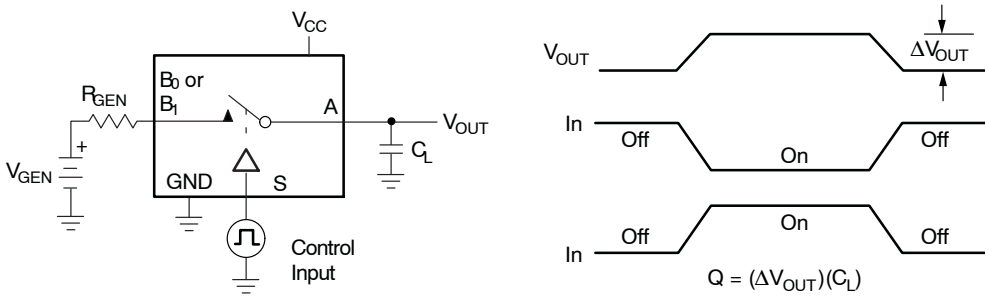


Figure 14. Charge Injection

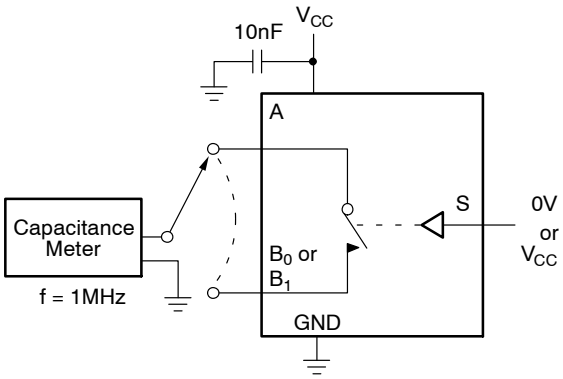


Figure 15. On / Off Capacitance Measurement Setup

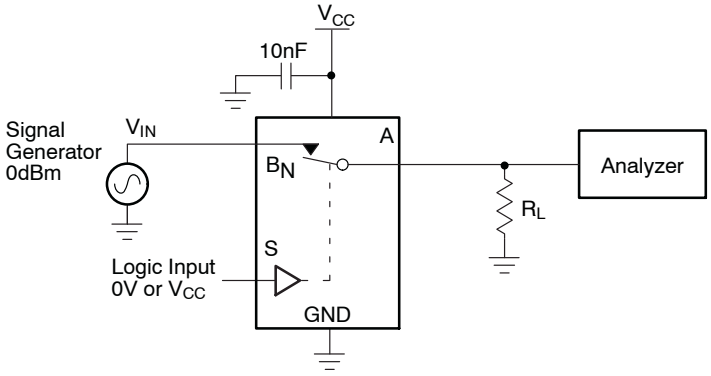


Figure 16. Bandwidth

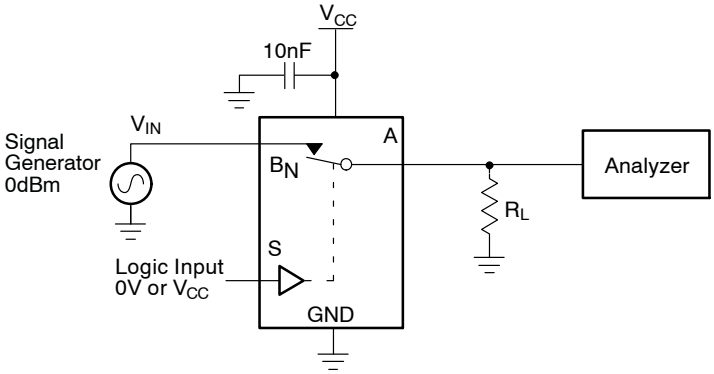
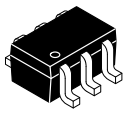


Figure 17. Harmonic Distortion

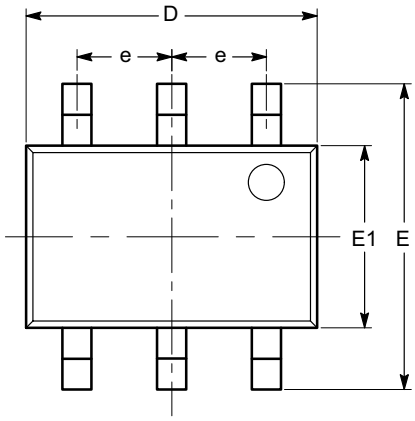
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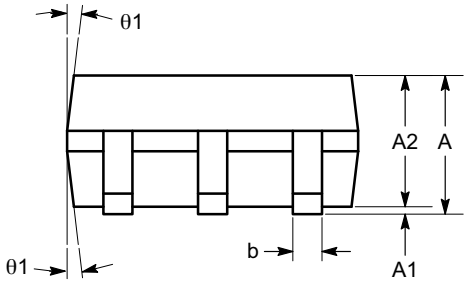
SC−88 (SC−70 6 Lead), 1.25x2
CASE 419AD
ISSUE A

DATE 07 JUL 2010

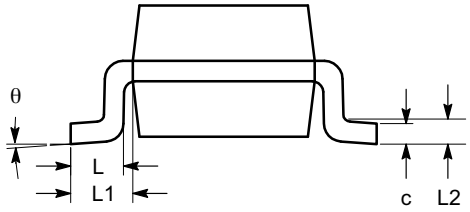


TOP VIEW

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	
θ	0°		8°
θ1	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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DESCRIPTION:	**SC−88 (SC−70 6 LEAD), 1.25X2**		**PAGE 1 OF 1**

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