

FSA4159

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

Features

- Power-Off Isolation ($V_{CC} = 0V$)
- 1Ω On Resistance (R_{ON}) for 4.5V V_{CC}
- 0.25Ω Maximum R_{ON} Flatness for 4.5V V_{CC}
- Space-Saving, Pb-Free, 6-Lead SC70 Surface Mount Package
- Broad V_{CC} Operating Range: 1.65V to 5.50V
- Fast Turn-On and Turn-Of Times
- Break-Before-Make Enable Circuitry
- Pb-Free “Green” Packaging

Description

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

Applications

- Cellular Phone
- Portable Media Player
- PDA

Ordering Information

Part Number	Pb-Free	Operating Temperature Range	Package	Packing Method
FSA4159P6X	Yes	-40°C to +85°C	6-Lead SC70, EIAJ SC88, 1,25mm Wide	3000 on Tape and Reel

Analog Symbols

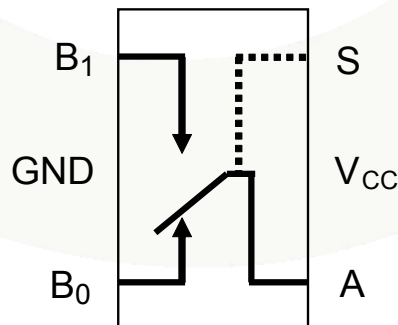


Figure 1. Analog Symbols

Pin Assignments

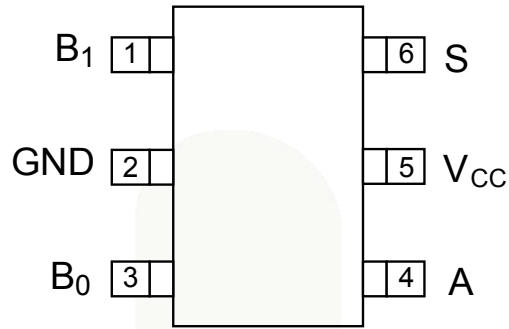


Figure 2. Pin Assignments (Top View)

Pin Definitions

Pin #	Name	Description
1	B1	Data Ports
2	GND	Ground
3	B0	Data Ports
4	A	Data Ports
5	V _{CC}	Supply Voltage
6	S	Control Input

Truth Table

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

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.	Unit
V_{CC}	Supply Voltage	-0.5	6.5	V
V_{SW}	Switch Voltage ⁽¹⁾	-0.5	$V_{CC} + 0.5$	V
V_{IN}	Input Voltage ⁽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 1ms 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	Max Junction Temperature		+150	°C
T_L	Lead Temperature (Soldering, 10 seconds)		+260	°C
ESD	Human Body Model (JEDEC: JESD22-A114)		4000	V
	Charged Device Model (JEDEC: JESD22-C101)		1500	V
	Machine Model		200	V

Note:

- The input and output negative 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.	Unit
V_{CC}	Supply Voltage	1.65	5.50	V
A_{SEL}	Control Input Voltage ⁽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

Note:

- Control Input must be held HIGH or LOW; it must not float.

Electrical Characteristics

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

Symbol	Parameter	V _{CC} (V)	Conditions	T _A =+25°C			T _A =-40 to +85°C		Unit
				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 or V _{CC}	-2		2	-100	100	nA
		3.60	V _{IN} =0 or V _{CC}	-2		2	-100	100	
		2.70	V _{IN} =0 or V _{CC}	-2		2	-20	20	
		1.95	V _{IN} =0 or V _{CC}	-2		2	-20	20	
I _{NO(OFF)} , I _{NC(OFF)}	Off-Leakage Current of Port B0 and B1	5.50	A=1V,4.5V B0 or B1=4.5, 1	-10		10	-50	50	nA
		3.60	A=1V,3.0V B0 or B1=3.0, 1	-10		10	-50	50	
		2.70	A=0.5V,2.3V B0 or B1=2.3, 0.5	-10		10	-50	50	
		1.95	A=0.3V,1.65V B0 or B1=1.65,0.3	-5		5	-20	20	
I _{NO(ON)} , I _{NC(ON)}	On-Leakage Current of Port B0 and B1	5.50	A=float B0 or B1=4.5, 1	-20		20	-100	100	nA
		3.60	A=float B0 or B1=3.0, 1	-10		10	-20	20	
		2.70	A=float B0 or B1=2.3, 0.5	-10		10	-20	20	
		1.95	A=float B0 or B1=1.65, 0.3	-5		5	-20	20	
I _{A(ON)}	On Leakage Current of Port A	5.50	A=1V,4.5V B0 or B1=1V, 4.5V or floating	-20		20	-100	100	nA
		3.60	A=1V, 3.0VB0 or B1=1V, 3.0V or floating	-10		10	-20	20	
		2.70	A=0.5V, 2.3V B0 or B1=0.5V, 2.3V or floating	-10		10	-20	20	
		1.95	A=0.3V, 1.65V B0 or B1=0.3V, 1.65V or floating	-5		5	-20	20	
I _{OFF}	Power Off Leakage Current of Port A & Port B	0	A=0 to V _{CC} B0 or B1=0 to V _{CC}	-1	0.01	1	-5	5	μA

Electrical Characteristics (Continued)

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

Symbol	Parameter	V _{CC} (V)	Conditions	T _A =+25°C			T _A =-40 to +85°C		Unit
				Min.	Typ.	Max.	Min.	Max.	
R _{PEAK}	Peak On Resistance	4.50	I _{OUT} =-100mA, B0 or B1=0 to V _{CC}		1.0	1.1		1.3	Ω
		3.00	I _{OUT} =-100mA, B0 or B1=0 to V _{CC}		1.2	1.5		1.8	
		2.30	I _{OUT} =-8mA, B0 or B1=0 to V _{CC}		1.5	2.0		2.5	
		1.65	I _{OUT} =2mA, B0 or B1=0 to V _{CC}	T _A =25, 85°C		4.0	10.0		
T _A = -40°C				10.0					
R _{ON}	Switch On Resistance ⁽³⁾	4.50	I _{OUT} =-100mA, B0 or B1=2.5V		0.8	0.9		1.1	Ω
		3.00	I _{OUT} =-100mA, B0 or B1=2.0V		1.0	1.3		1.6	
		2.30	I _{OUT} =-8mA, B0 or B1=1.8V		1.4	2.0		2.4	
		1.65	I _{OUT} =-2mA, B0 or B1=1.5V		1.7	2.5		3.5	
Δ R _{ON}	On Resistance Matching Between Channels ⁽⁴⁾	4.50	I _{OUT} =-100mA, B0 or B1=2.5V		0.05	0.10		0.10	Ω
		3.00	I _{OUT} =-100mA, B0 or B1=2.0V		0.1	0.15		0.15	
		2.30	I _{OUT} =-8mA, B0 or B1=1.8V		0.15	0.20		0.20	
		1.65	I _{OUT} =-2mA, B0 or B1=1.5V		0.15	0.40		0.40	
R _{FLAT(ON)}	On Resistance Flatness ⁽⁵⁾	4.50	I _{OUT} =-100mA, B0 or B1=1.0V, 1.5V, 2.5V		0.075	0.250		0.250	Ω
		3.00	I _{OUT} =-100mA, B0 or B1=0.8V, 2.0V		0.1	0.3		0.3	
		2.30	I _{OUT} =-8mA, B0 or B1=0.8V, 1.8V		0.2	1.0		1.0	
		1.65	I _{OUT} =-2mA, B0 or B1=0.6V, 1.5V		3.5				
I _{CC}	Quiescent Supply Current	5.50	V _{IN} =0 or V _{CC} , I _{OUT} =0		10	50		500	nA
		3.60	V _{IN} =0 or V _{CC} , I _{OUT} =0		1.0	25.0		100	
		2.70	V _{IN} =0 or V _{CC} , I _{OUT} =0		0.5	20.0		50	
		1.95	V _{IN} =0 or V _{CC} , I _{OUT} =0		0.5	15.0		50	

Notes:

3. On resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.
4. Δ 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 value are at $V_{CC} = 1.8V, 2.5V, 3.0V, 5.0V$ at $25^{\circ}C$ unless otherwise specified.

Symbol	Parameter	V_{CC} (V)	Conditions	$T_A = +25^{\circ}C$			$T_A = -40$ to $+85^{\circ}C$		Unit	Figure
				Min.	Typ.	Max.	Min.	Max.		
t_{ON}	Turn-On Time	4.50 to 5.50	$B0$ or $B1 = V_{CC}$, $R_L = 50\Omega$, $C_L = 35pF$	1.0	16.0	30.0	1.0	35.0	ns	Figure 10
		3.00 to 3.60		5.0	21.0	35.0	3.0	50.0		
		2.30 to 2.70		5.0	28.0	40.0	5.0	50.0		
		1.65 to 1.95		10.0	50.0	70.0	10.0	75.0		
t_{OFF}	Turn-Off Time	4.50 to 5.50	$B0$ or $B1 = V_{CC}$, $R_L = 50\Omega$, $C_L = 35pF$	1.0	13.0	20.0	1.0	30.0	ns	Figure 10
		3.00 to 3.60		1.0	15.0	20.0	1.0	30.0		
		2.30 to 2.70		2.0	20.0	35.0	2.0	50.0		
		1.65 to 1.95		2.0	28.0	40.0	2.0	50.0		
t_{BBM}	Break-Before-Make Time	4.50 to 5.50	$B0$ or $B1 = V_{CC}$, $R_L = 50\Omega$, $C_L = 35pF$		3.0		0.1	20.0	ns	Figure 11
		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	$C_L = 1.0nF$, $V_{GEN} = 0V$, $R_{GEN} = 0\Omega$		15				pC	Figure 13
		3.30			11					
		2.50			8					
		1.65			6					
OIRR	Off-Isolation	1.8 to 5.0	$f = 1MHz$, $R_L = 50\Omega$		-60				dB	Figure 12
Xtalk	Crosstalk	1.8 to 5.0	$f = 1MHz$, $R_L = 50\Omega$		-60				dB	Figure 12
BW	-3db Bandwidth	5.50	$R_L = 50\Omega$		180				MHz	Figure 6 Figure 7 Figure 15
		3.30			180					
		2.50			180					
		1.65			180					
THD	Total Harmonic Distortion	1.80	$R_L = 600\Omega$, $V_{IN} = 0.5V_{PP}$, $f = 20Hz$ to 20kHz		.006				%	Figure 9 Figure 16
		5.00			.002					

Capacitance

Symbol	Parameter	V_{CC} (V)	Conditions	$T_A = +25^{\circ}C$			Unit
				Min.	Typ.	Max.	
C_{IN}	Control Pin Input Capacitance	0	$f = 1MHz$ See Figure 9		1.5		pF
C_{OFF}	B Port Off Capacitance	1.65 to 5.50	$f = 1MHz$ See Figure 9		12		pF
C_{ON}	A Port On Capacitance	1.65 to 5.50	$f = 1MHz$ See Figure 9		41		pF

Typical Performance Characteristics

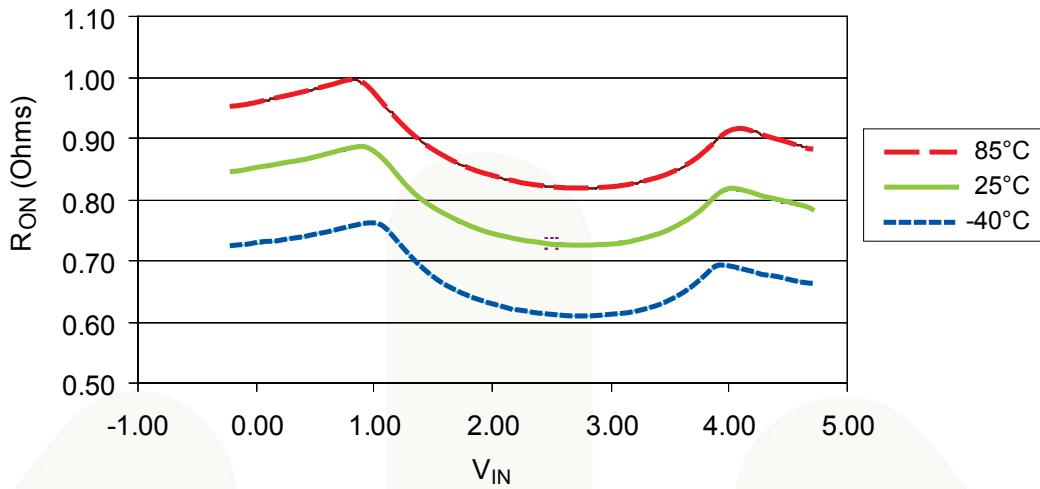


Figure 3. Switch R_{ON} (V_{CC} = 4.5V)

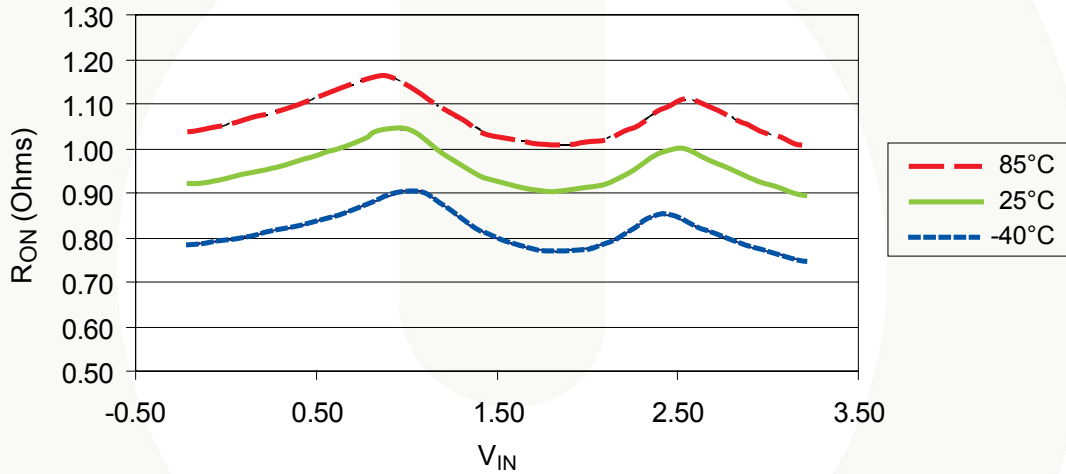


Figure 4. Switch R_{ON} (V_{CC} = 3.0V)

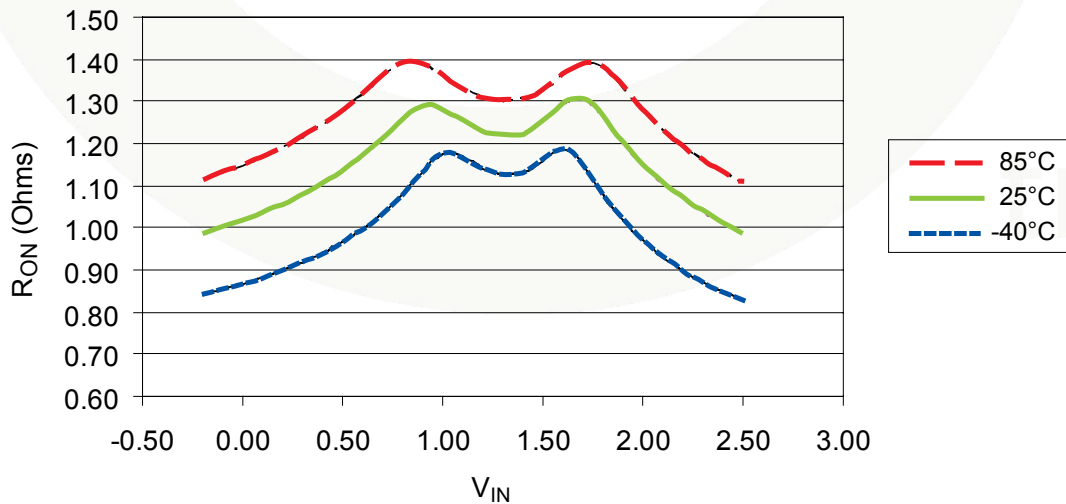


Figure 5. Switch R_{ON} (V_{CC} = 2.3V)

Typical Performance Characteristics (Continued)

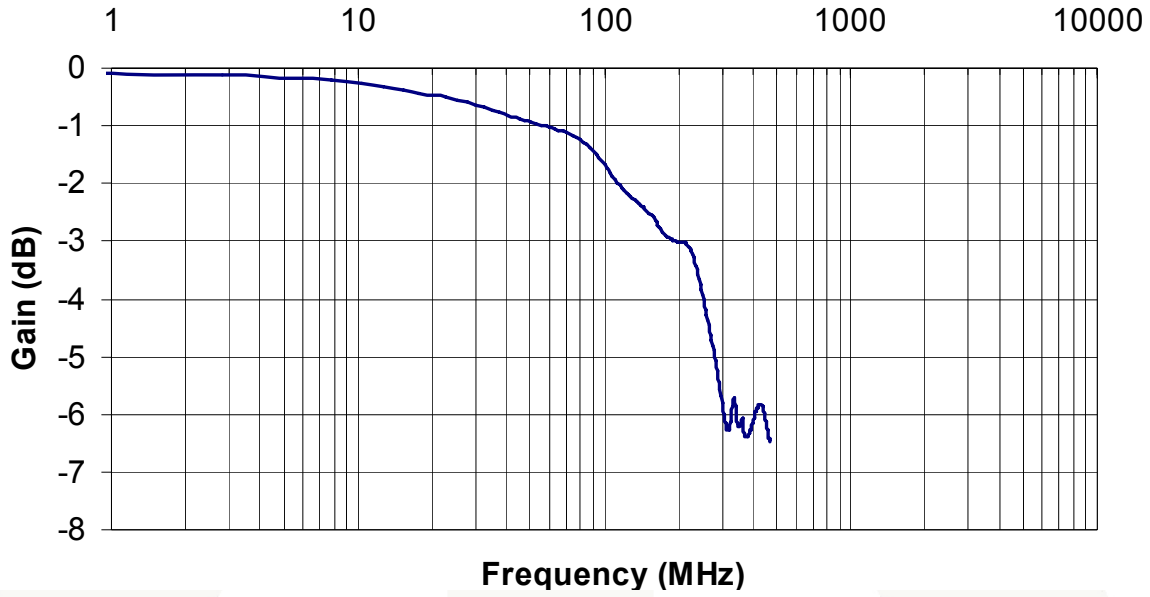


Figure 6. Frequency Response ($C_L = 0pF$, $V_{CC} = 5.5V$)

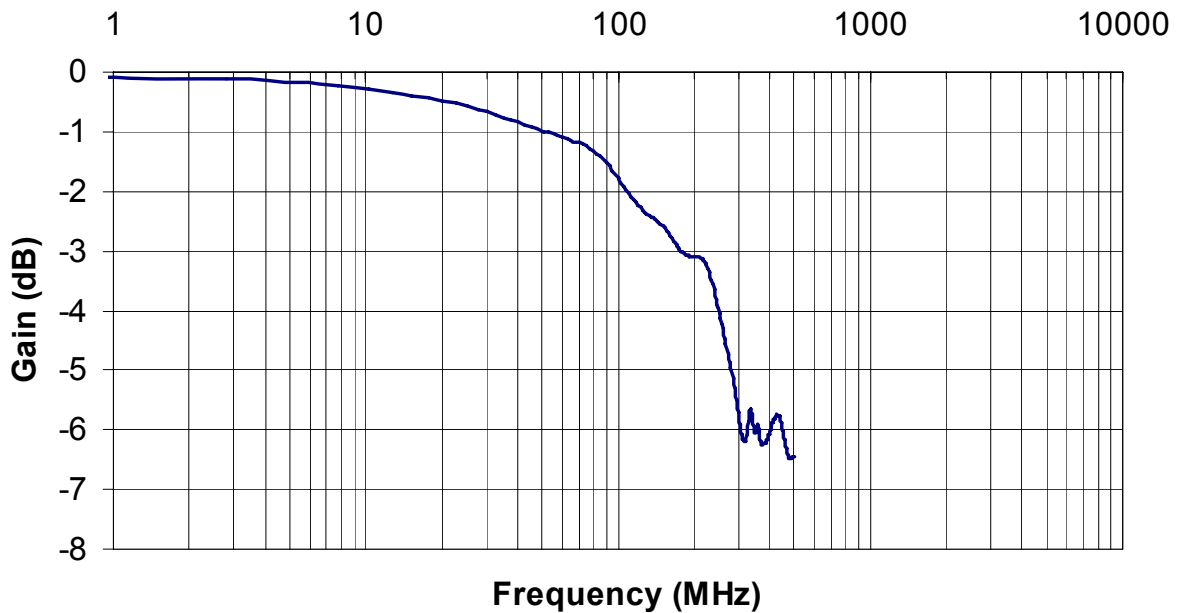


Figure 7. Frequency Response ($C_L = 0pF$, $V_{CC} = 3.3V$)

Typical Performance Characteristics (Continued)

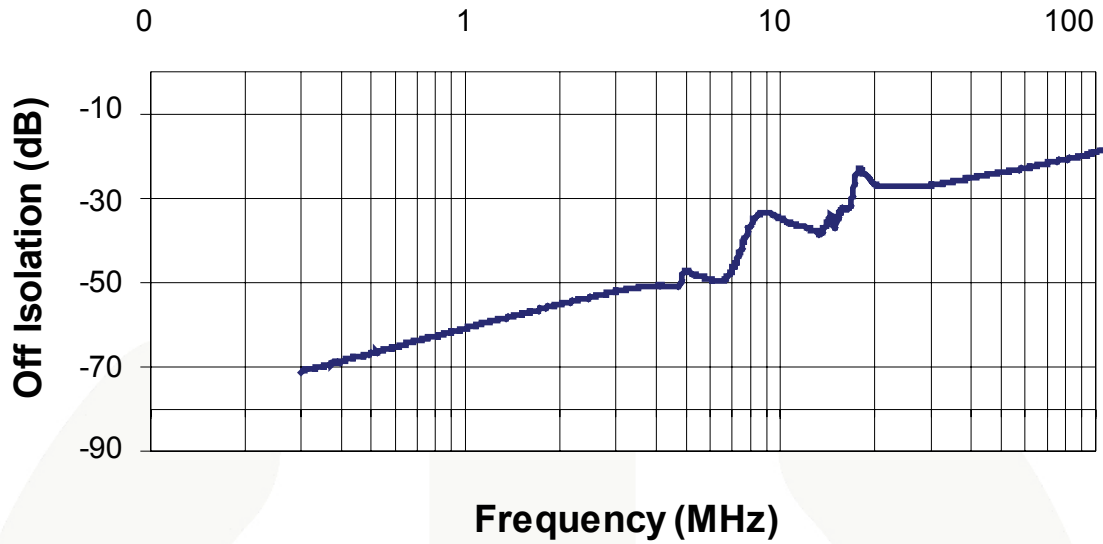


Figure 8. Off Isolation (V_{CC} = 5.0V)

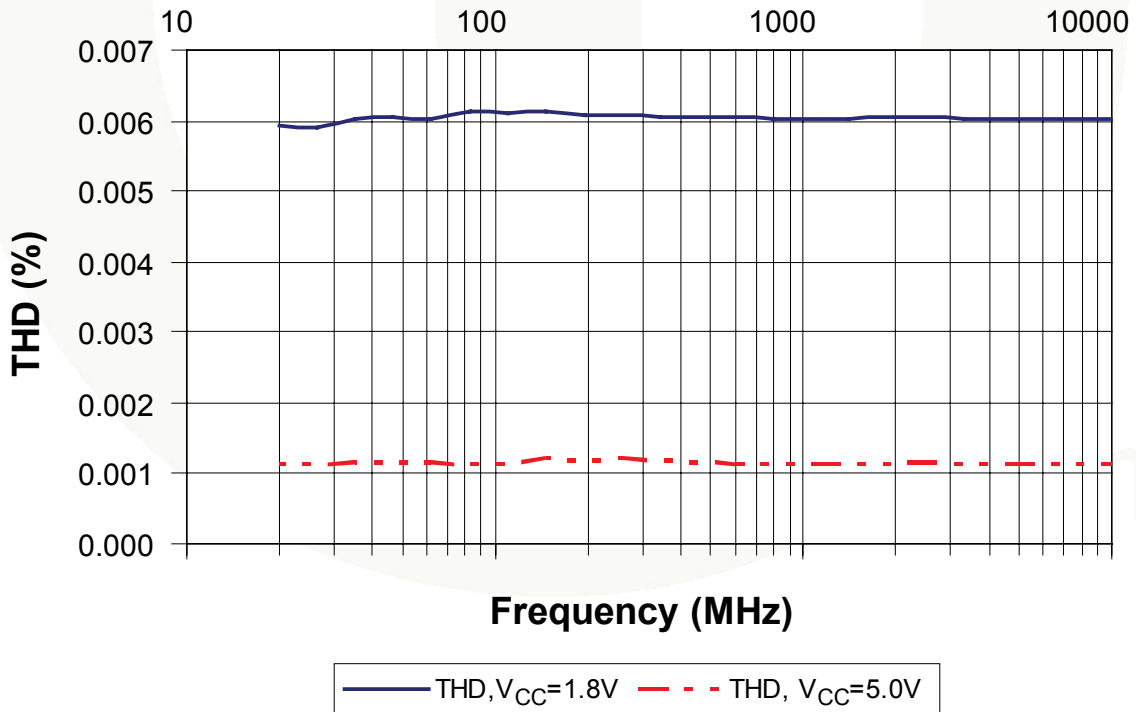
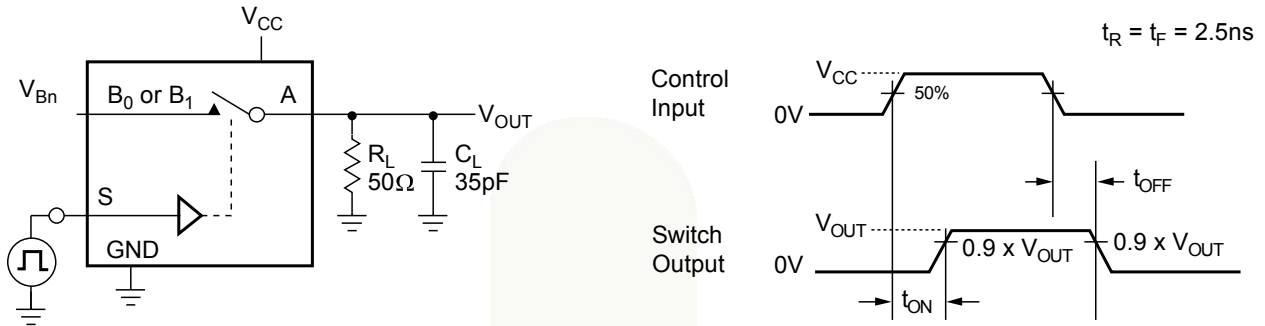


Figure 9. Total Harmonic Distortion, Frequency Response (C_L = 0pF)

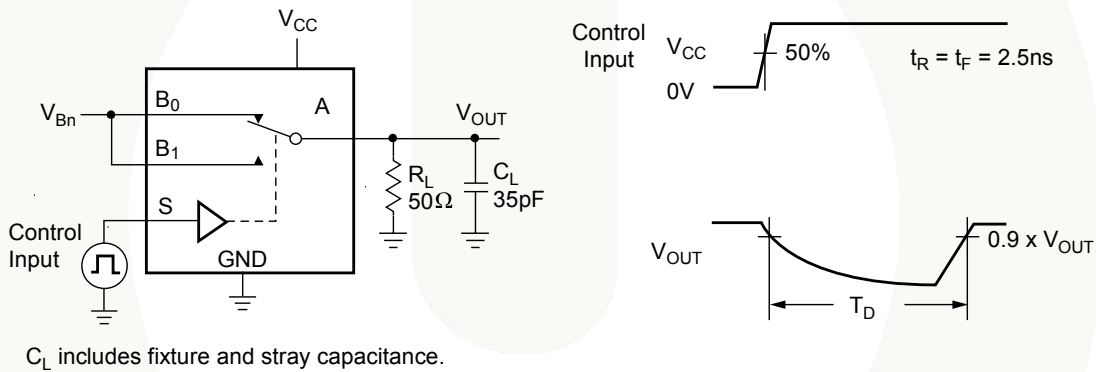
Test Diagrams



C_L includes fixture and stray capacitance.

Logic input waveforms inverted for switches that have the opposite logic sense.

Figure 10. Turn On / Off Timing



C_L includes fixture and stray capacitance.

Figure 11. Break-Before-Make Timing

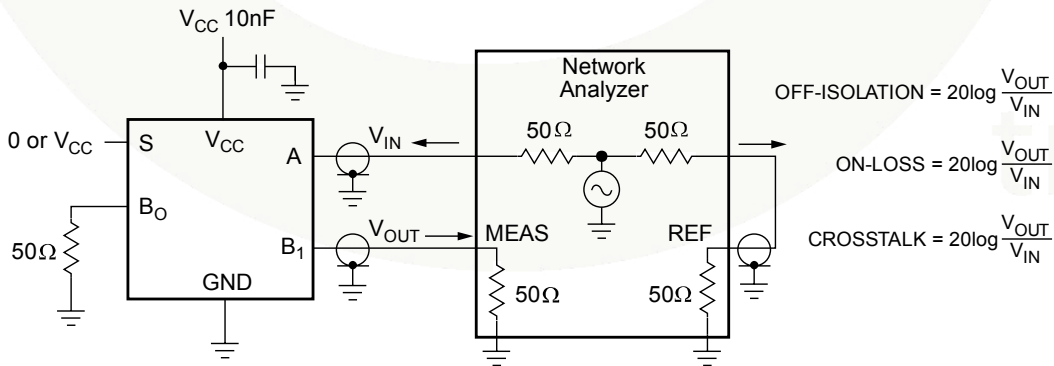


Figure 12. Off Isolation and Crosstalk

Test Diagrams (Continued)

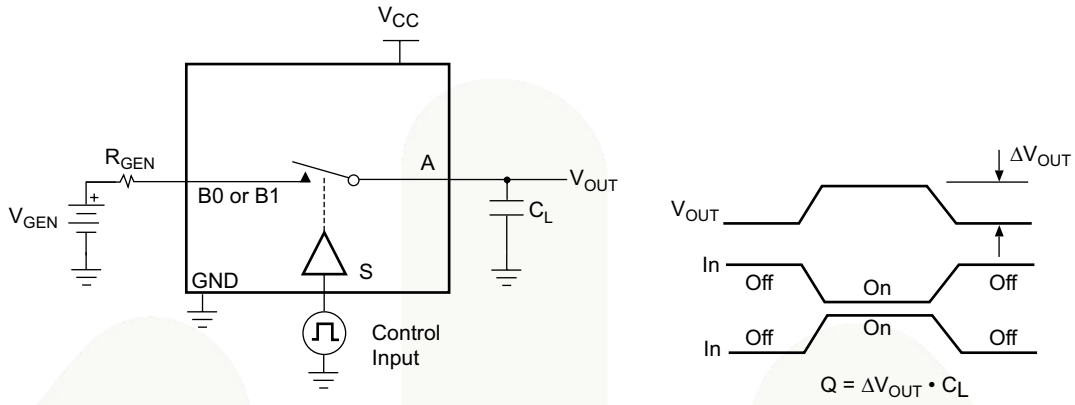


Figure 13. Charge Injection

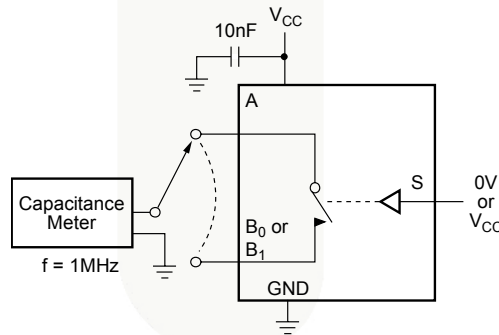


Figure 14. On / Off Capacitance Measurement Setup

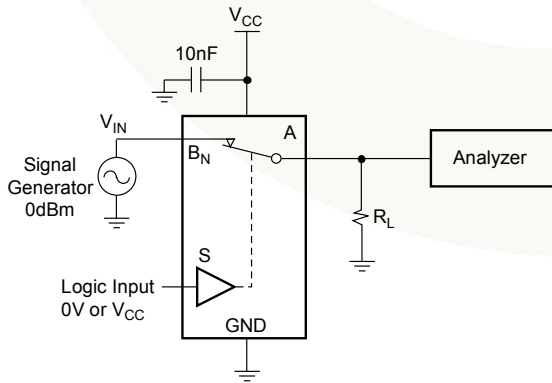


Figure 15. Bandwidth

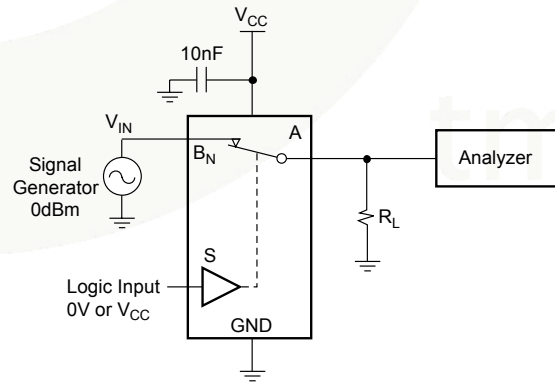
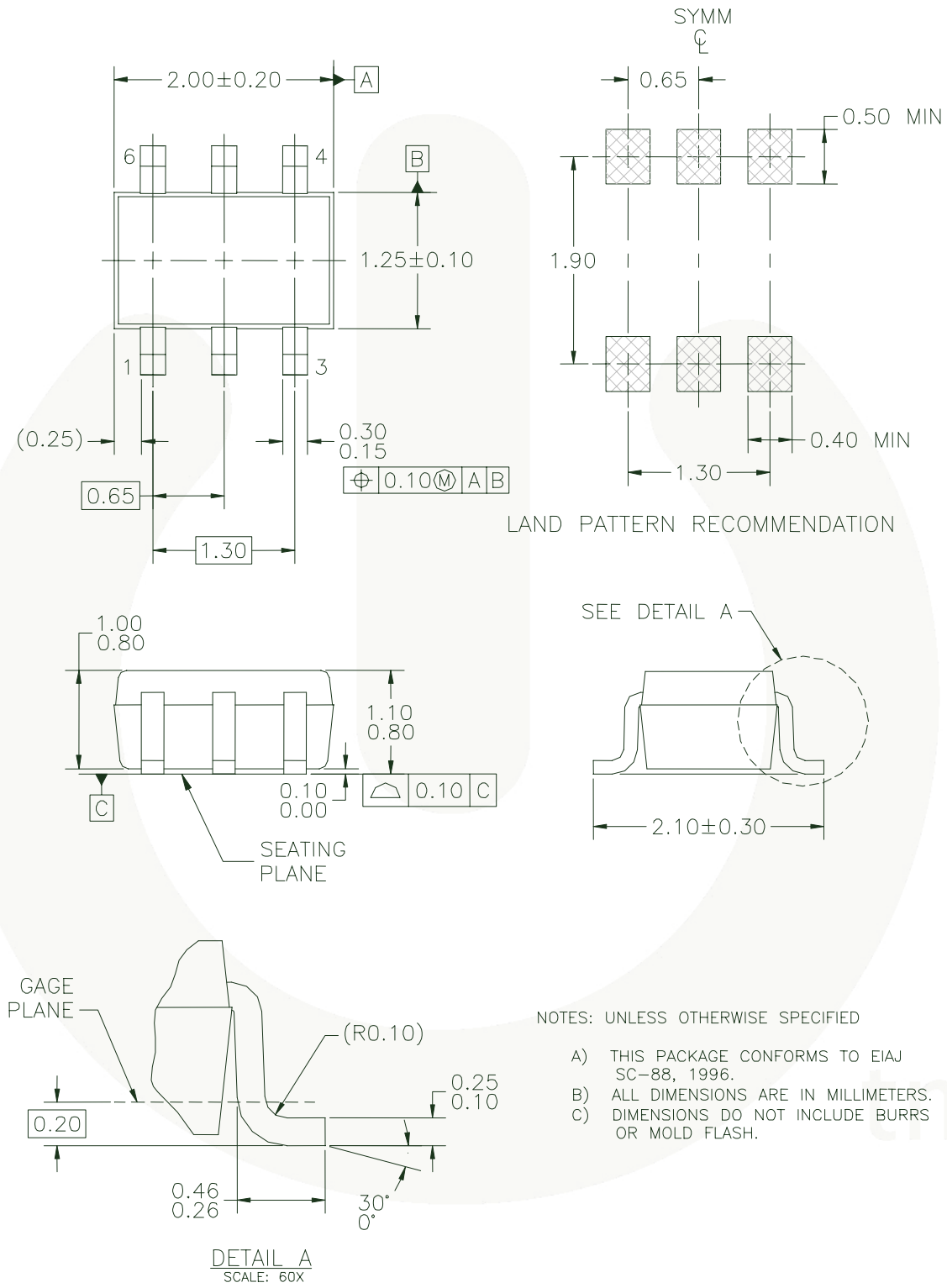


Figure 16. Harmonic Distortion

Physical Dimensions

Dimensions are in millimeters (inches) unless otherwise noted.




MAA06AREV5

Figure 17. 6-Lead SC70, EIAJ SC88, 1.25mm Wide Package

TRADEMARKS

The following are registered and unregistered trademarks and service marks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

ACEX [®]	Green FPS [™] e-Series [™]	POWEREDGE [®]	SuperSOT [™] -8
Build it Now [™]	GTO [™]	Power-SPM [™]	SyncFET [™]
CorePLUS [™]	<i>i-Lo</i> [™]	PowerTrench [®]	The Power Franchise [®]
CROSSVOLT [™]	IntelliMAX [™]	Programmable Active Droop [™]	 ™
CTL [™]	ISOPLANAR [™]	QFET [®]	TinyBoost [™]
Current Transfer Logic [™]	MegaBuck [™]	QS [™]	TinyBuck [™]
EcoSPARK [®]	MICROCOUPLER [™]	QT Optoelectronics [™]	TinyLogic [®]
FACT Quiet Series [™]	MicroFET [™]	Quiet Series [™]	TINYOPTO [™]
FACT [®]	MicroPak [™]	RapidConfigure [™]	TinyPower [™]
FAST [®]	Motion-SPM [™]	SMART START [™]	TinyPWM [™]
FastvCore [™]	OPTOLOGIC [®]	SPM [®]	TinyWire [™]
FPS [™]	OPTOPLANAR [®]	STEALTH [™]	μSerDes [™]
FRFET [®]	PDP-SPM [™]	SuperFET [™]	UHC [®]
Global Power Resource SM	Power220 [®]	SuperSOT [™] -3	UniFET [™]
Green FPS [™]	Power247 [®]	SuperSOT [™] -6	VCX [™]

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild Semiconductor. The datasheet is printed for reference information only.

Rev. 129