# FAIRCHILD™

## Is Now Part of

# ON Semiconductor®

## To learn more about ON Semiconductor, please visit our website at
### www.onsemi.com

**FAIRCHILD**
SEMICONDUCTOR®

February 2008

# FSA5157
# 0.4Ω Low-Voltage SPDT Analog Switch

## Features

- Typical 0.4Ω On Resistance ($R_{ON}$) for +2.7V Supply
- FSA5157 Features Less than 12µA $I_{CCT}$ Current When S Input is Lower than $V_{CC}$
- 0.25Ω Maximum $R_{ON}$ Flatness for +2.7V Supply
- 1.0 x 1.45mm 6-Lead MicroPak™ Package
- Broad $V_{CC}$ Operating Range: 1.65V to 4.3V
- Low THD (0.02% Typical for 32Ω Load)
- High-Current Handling Capability (350mA Continuous Current Under 3.3V Supply)
- Control Logic is 1.8V CMOS Logic Compatible

## Applications

- Cellular Phone
- PDA
- Portable Media Player

## General 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 0.4Ω impedance, sub-µA current consumption, and 1.65V to 4.3V 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 1.8V, 2.5V, and 3.3V.

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

## Ordering Information

| Order Number | Top Mark | Package Description | Packing Method |
|---|---|---|---|
| FSA5157P6X | C57 | 6-Lead SC70, EIAJ SC88, 1.25mm Wide | 3000 Units on Tape and Reel |
| FSA5157L6X | FT | 6-Lead MicroPak, 1.0mm Wide | 5000 Units on Tape and Reel |

All packages are lead free per JEDEC: J-STD-020B standard.

## Application Diagram
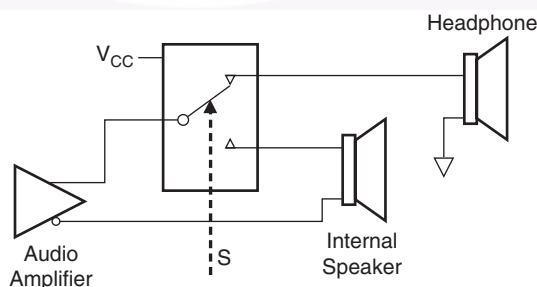


**Figure 1. Application Diagram**

MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

## Pin Assignments
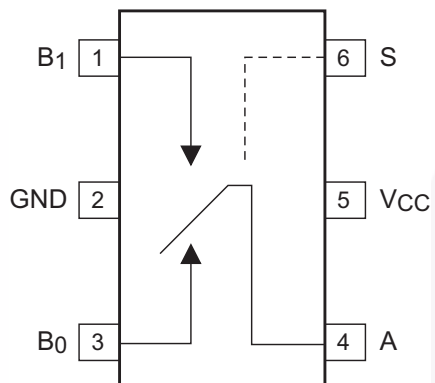


**Figure 2. 6-Lead SC70**
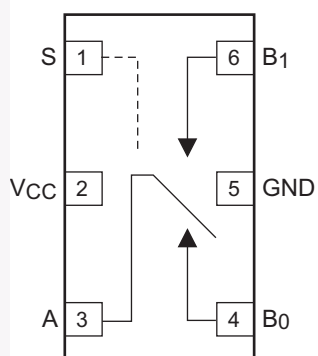


**Figure 3. 6-Lead MicroPak™**

## Truth Tables

| Control Input(s) | Function |
|---|---|
| LOW Logic Level | $B_0$ Connected to A |
| HIGH Logic Level | $B_1$ Connected to A |

## Pin Descriptions

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

## 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 | Units |
|--------|-----------|------|-----|-------|
| $V_{CC}$ | Supply Voltage | −0.5 | 5.5 | V |
| $V_S$ | Switch Voltage[1] | −0.5 | $V_{CC} + 0.3V$ | V |
| $V_{IN}$ | Input Voltage[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 1ms duration, <10% Duty Cycle) | | 500 | mA |
| $P_D$ | SC70 6L Package | | 180 | mW |
| | MicroPak 6L 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 |

**Note:**

1. The input and output negative voltage 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. | Rating |
|--------|-----------|------|------|--------|
| $V_{CC}$ | Supply Voltage | 1.65 | 4.30 | V |
| $V_{IN}$ | Control Input Voltage[2] | 0 | $V_{CC}$ | V |
| $V_{IN}$ | Switch Input Voltage | 0 | $V_{CC}$ | V |
| $T_A$ | Operating Temperature | −40 | +85 | °C |

**Note:**

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

## 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 | | Units |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 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 | $V_{IN}$ = 0V 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 = 0.3V, $V_{CC}$ −0.3V, $B_0$ or $B_1$ = 0.3V, $V_{CC}$ − 0.3V or Floating | 1.95 to 4.3 | -10 | | 10 | −50 | 50 | nA |
| $I_{A(ON)}$ | On Leakage Current of Port A | A = 0.3V, $V_{CC}$ −0.3V, $B_0$ or $B_1$ = 0.3V, $V_{CC}$ − 0.3V or Floating | 1.95 to 4.3 | −20 | | 20 | −100 | 100 | nA |
| $R_{ON}$ | Switch On Resistance[3] | $I_{OUT}$ = 100mA, $B_0$ or $B_1$ = 0V, 0.7V, 3.6V, 4.3V | 4.3 | | 0.36 | | | 0.60 | Ω |
| | | $I_{OUT}$ = 100mA, $B_0$ or $B_1$ = 0V, 0.7V, 2.0V, 2.7V | 2.7 | | 0.4 | | | 0.7 | |
| | | $I_{OUT}$ = 100mA, $B_0$ or $B_1$ = 0V, 0.7V, 2.0V, 2.3V | 2.3 | | 0.55 | | | 0.80 | |
| | | $I_{OUT}$ = 100mA, $B_0$ or $B_1$ = 0.7V | 1.65 | | 1.5 | 2.5 | | 3.0 | |
| $\Delta R_{ON}$ | On Resistance Matching Between Channels[4] | $I_{OUT}$ = 100mA, $B_0$ or $B_1$ = 0.7V | 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[5] | $I_{OUT}$ = 100mA, $B_0$ or $B_1$ = 0V 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 | $V_{IN}$ = 0V or $V_{CC}$, $I_{OUT}$ = 0 | 4.3 | −100 | 30 | 100 | −500 | 500 | nA |
| $I_{CCT}$ | Increase in $I_{CC}$ per Control Input | $V_{IN}$ = 1.8V | 4.3 | | 7.0 | 12.0 | | 15.0 | μA |
| | | $V_{IN}$ = 2.6V | 4.3 | | 3.0 | 6.0 | | 7.0 | |

**Notes:**

3. On resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.
4. $\Delta R_{ON} = R_{ONmax} - R_{ONmin}$ 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 | | Units | Figure |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | Min. | Max. | | |
| $t_{ON}$ | Turn-On Time | $B_0$ or $B_1$ = 1.5V, $R_L$ = 50Ω, $C_L$ = 35pF | 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 $B_1$ = 1.5V, $R_L$ = 50Ω, $C_L$ = 35pF | 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 $B_1$ = 1.5V, $R_L$ = 50Ω, $C_L$ = 35pF | 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, $V_{GEN}$ = 0V, $R_{GEN}$ = 0Ω | 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 = 100kHz, $R_L$ =50Ω, $C_L$ = 5pF (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 = 100kHz, $R_L$ =50Ω, $C_L$ = 5pF (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 | $R_L$ = 50Ω | 1.65 to 4.3 | | 80 | | | | MHz | Figure 13 |
| THD | Total Harmonic Distortion | | 3.6 to 4.3 | | | | | | % | Figure 14 |
| | | $R_L$ = 32Ω, $V_{IN}$ = 2V_PP, f = 20Hz to 20kHz | 2.7 to 3.6 | | 0.02 | | | | | |
| | | $R_L$ = 32Ω, $V_{IN}$ = 1.5V_PP, f = 20Hz to 20kHz | 2.3 to 2.7 | | 0.036 | | | | | |
| | | $R_L$ = 32Ω, $V_{IN}$ =1.2V_PP, f = 20Hz to 20kHz | 1.65 to 1.95 | | 0.01 | | | | | |

## Capacitance

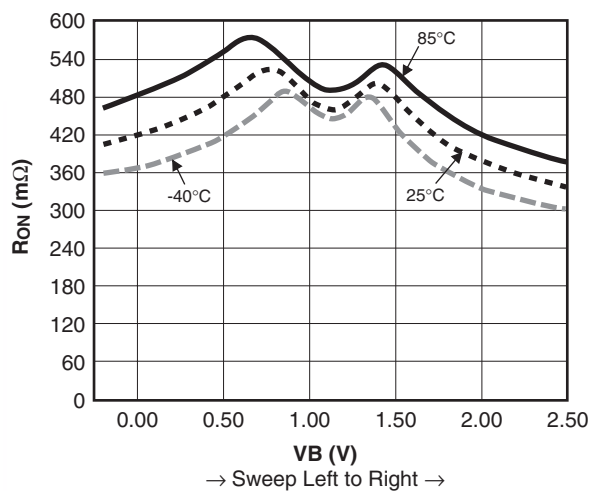| Symbol | Parameter | Conditions | V_CC (V) | T_A =+25°C | | | T_A =40°C to +85°C | | Units | Figure |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | Min. | Max. | | |
| $C_{IN}$ | Control Pin Input Capacitance | f = 1MHz | 0.0 | | 1.5 | | | | pF | Figure 12 |
| $C_{OFF}$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

## Typical Characteristics



**Figure 4. R$_{ON}$ Switch On Resistance, I$_{ON}$ = 100mA, V$_{CC}$ = 2.3V B0**



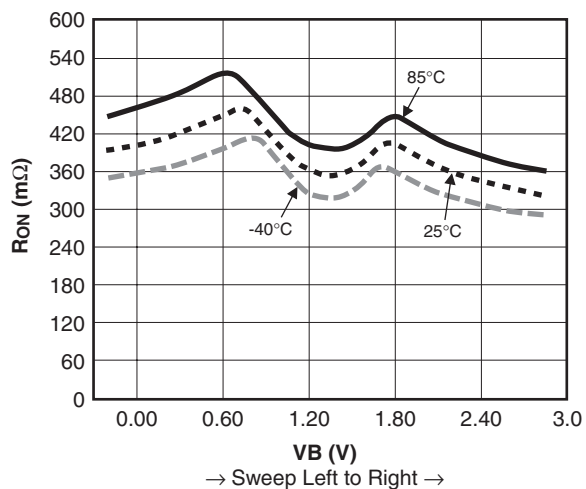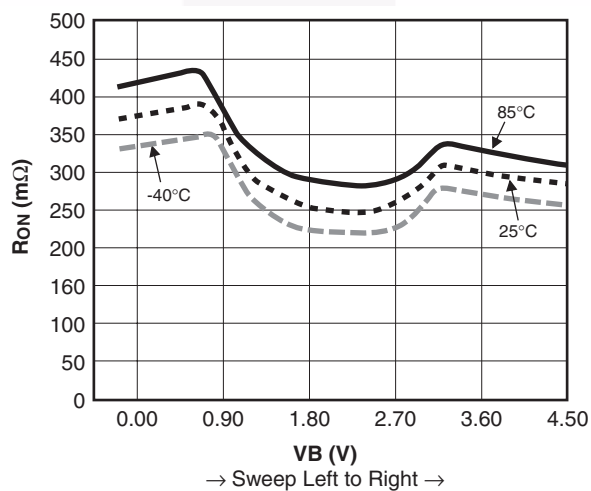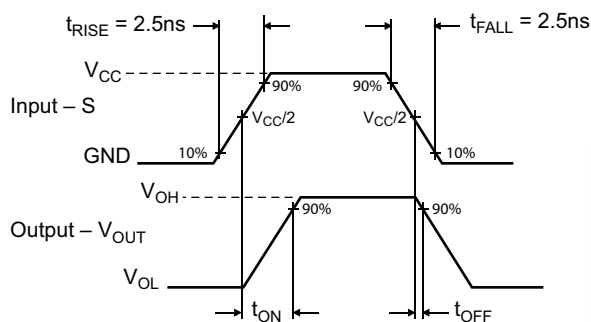**Figure 5. R$_{ON}$ Switch On Resistance, I$_{ON}$ = 100mA, V$_{CC}$ = 2.7V B0**



**Figure 6. R$_{ON}$ Switch On Resistance, I$_{ON}$ = 100mA, V$_{CC}$ = 4.3V B0**

# AC Loading and Waveforms
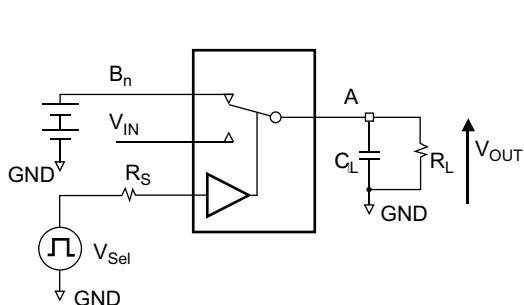


**Notes:**

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

**Figure 7. Turn-Off Timing**



*$C_L$ includes fixture and stray capacitance

**Figure 8. Break-Before-Make Timing**



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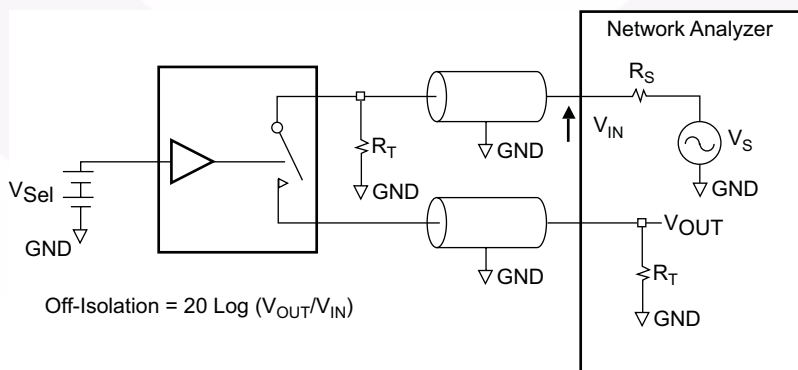
**Figure 9.  Off Isolation**

## AC Loading and Waveforms (continued)



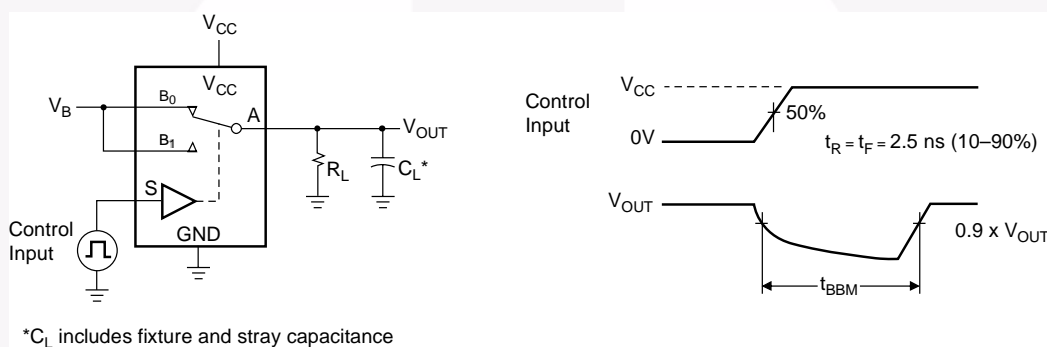R$_S$ and R$_T$ are functions of the application environment (50, 75, or 100).

Crosstalk = 20 Log (V$_{OUT}$/V$_{IN}$)
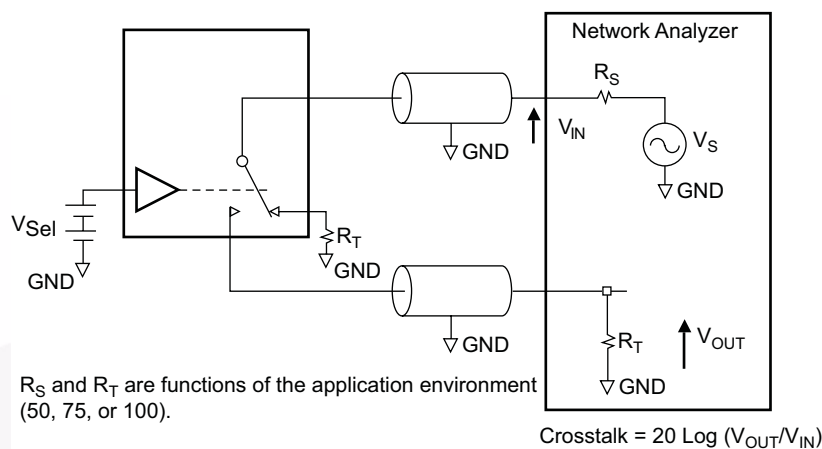
**Figure 10. Non-Adjacent Channel-to-Channel Crosstalk**



*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 Loading and Waveforms (continued)
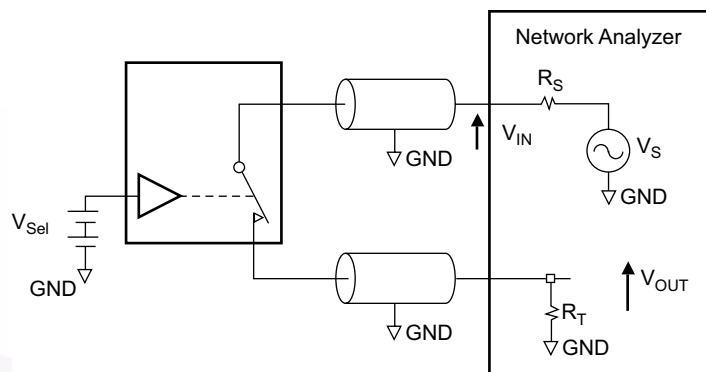


**Figure 13. Bandwidth**
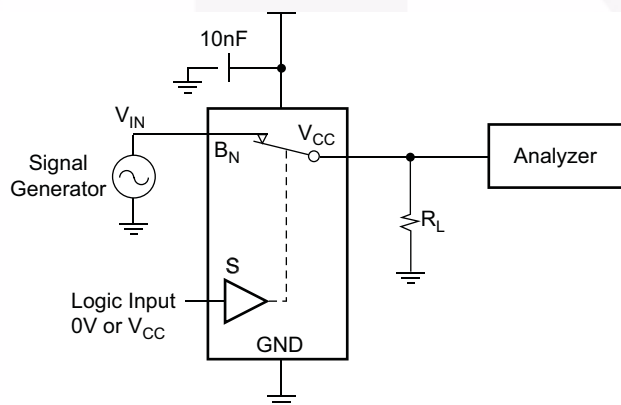


**Figure 14. Harmonic Distortion**

## Physical Dimensions



SYMM ℄

0.65

0.50 MIN

1.90

0.40 MIN

1.30

LAND PATTERN RECOMMENDATION

2.00±0.20  A

B

1.25±0.10

(0.25)

0.30
0.15

0.65

⊕ 0.10(M) A B

1.30

1.00
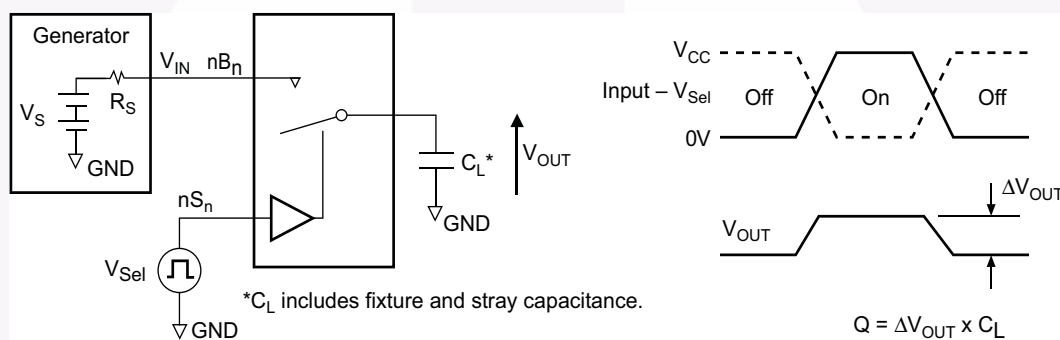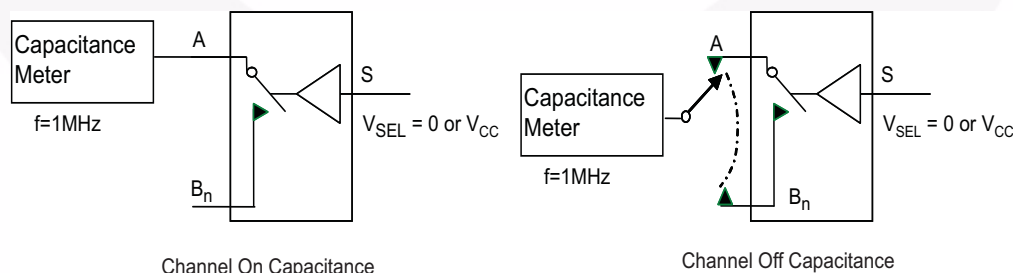0.80

1.10
0.80

0.10
0.00

⌒ 0.10 C

C

SEATING PLANE

SEE DETAIL A

2.10±0.30

GAGE PLANE

(R0.10)

0.25
0.10

0.20

0.46
0.30

30°
0°

DETAIL A
SCALE: 2X

NOTES: UNLESS OTHERWISE SPECIFIED

A) THIS PACKAGE CONFORMS TO EIAJ
   SC-88A, 1996.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS DO NOT INCLUDE BURRS
   OR MOLD FLASH.

MAA06AREV5

**Figure 15.  6-Lead SC70, EIAJ SC88, 1.25mm Wide**

*Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.*

*Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:*
*http://www.fairchildsemi.com/packaging/*

## Physical Dimensions

2X

△ 0.05 C — 1.45 — B

2X

△ 0.05 C

1.00

TOP VIEW

A

0.55MAX

// 0.05 C

0.05
0.00

△ 0.05 C

C

(1)

(0.49)
5X

(0.75)

(0.52)
1X

(0.30)
6X

PIN 1

RECOMMENED
LAND PATTERN

DETAIL A

0.25
0.15 6X

1.0

⊕ 0.10 Ⓜ C B A
0.05 Ⓜ C

0.35 5X
0.25

0.40 5X
0.30

(0.05)
6X

0.5

(0.13)
4X

BOTTOM VIEW

0.45
0.35

0.10 6X
0.00

0.40
0.30

DETAIL A
PIN 1 TERMINAL

0.075 X 45°
CHAMFER

Notes:

1. CONFORMS TO JEDEC STANDARD M0-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
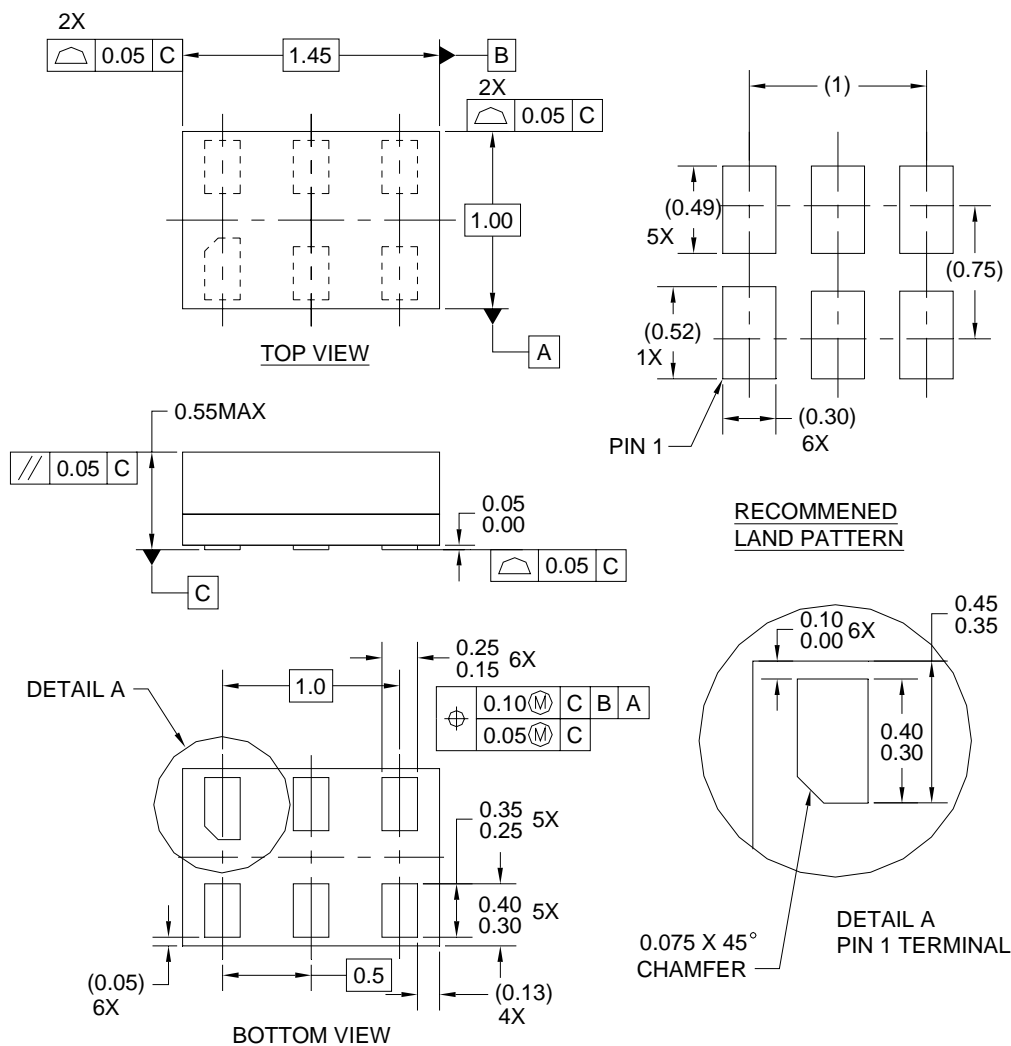3. DRAWING CONFORMS TO ASME Y14.5M-1994

MAC06AREVC

**Figure 16. 6-Lead MicroPak™, 1.0mm Wide**

*Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.*

*Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:*
*http://www.fairchildsemi.com/packaging/*

*For MicroPak tape and reel specifications, please visit Fairchild Semiconductor's online packaging area:*
*http://www.fairchildsemi.com/products/logic/pdf/micropak_tr.pdf*

## TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

| | | | |
|---|---|---|---|
| ACEx® | FPS™ | PDP-SPM™ | SupreMOS™ |
| Build it Now™ | FRFET® | Power220® | SyncFET™ |
| CorePLUS™ | Global Power Resource℠ | POWEREDGE® | SYSTEM GENERAL® |
| CROSSVOLT™ | Green FPS™ | Power-SPM™ | The Power Franchise® |
| CTL™ | Green FPS™ e-Series™ | PowerTrench® | |
| Current Transfer Logic™ | GTO™ | Programmable Active Droop™ | the power franchise |
| EcoSPARK® | i-Lo™ | QFET® | |
| EZSWITCH™ * | IntelliMAX™ | QS™ | TinyBoost™ |
| EZ™ | ISOPLANAR™ | QT Optoelectronics™ | TinyBuck™ |
| | MegaBuck™ | Quiet Series™ | TinyLogic® |
| F® | MICROCOUPLER™ | RapidConfigure™ | TINYOPTO™ |
| Fairchild® | MicroFET™ | SMART START™ | TinyPower™ |
| Fairchild Semiconductor® | MicroPak™ | SPM® | TinyPWM™ |
| FACT Quiet Series™ | MillerDrive™ | STEALTH™ | TinyWire™ |
| FACT® | Motion-SPM™ | SuperFET™ | µSerDes™ |
| FAST® | OPTOLOGIC® | SuperSOT™-3 | UHC® |
| FastvCore™ | OPTOPLANAR® | SuperSOT™-6 | Ultra FRFET™ |
| FlashWriter®* | | SuperSOT™-8 | UniFET™ |
| | | | VCX™ |

* EZSWITCH™ and FlashWriter® are trademarks of System General Corporation, used under license by Fairchild Semiconductor.

## 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 the 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. I33