

# NC7SB3157, FSA3157

## Low-Voltage SPDT Analog Switch or 2:1 Multiplexer / De-multiplexer Bus Switch

### Features

- Useful in Both Analog and Digital Applications
- Space-Saving, SC70 6-Lead Surface Mount Package
- Ultra-Small, MicroPak™ Leadless Package
- Low On Resistance:  $<10\Omega$  on Typical at 3.3V  $V_{CC}$
- Broad  $V_{CC}$  Operating Range: 1.65V to 5.5V
- Rail-to-Rail Signal Handling
- Power-Down, High-Impedance Control Input
- Over-Voltage Tolerance of Control Input to 7.0V
- Break-Before-Make Enable Circuitry
- 250MHz, 3dB Bandwidth

### Description

The NC7SB3157 / FSA3157 is a high-performance, single-pole / double-throw (SPDT) analog switch or 2:1 multiplexer / de-multiplexer bus switch.

The device is fabricated with advanced sub-micron CMOS technology to achieve high-speed enable and disable times and low on resistance. The break-before-make select circuitry prevents disruption of signals on the B Port due to both switches temporarily being enabled during select pin switching. The device is specified to operate over the 1.65 to 5.5V  $V_{CC}$  operating range. The control input tolerates voltages up to 5.5V, independent of the  $V_{CC}$  operating range.

### Ordering Information

| Part Number  | Top Mark | Eco Status | Package Description                          | Packing Method              |
|--------------|----------|------------|--|-----------------------------|
| NC7SB3157P6X | B7A      | RoHS       | 6-Lead, SC70, EIAJ SC88, 1.25mm Wide Package | 3000 Units on Tape and Reel |
| NC7SB3157L6X | BB       | RoHS       | 6-Lead, MicroPak 1.0mm Wide Package          | 5000 Units on Tape and Reel |
| FSA3157P6X   | B7A      | RoHS       | 6-Lead, SC70, EIAJ SC88, 1.25mm Wide Package | 3000 Units on Tape and Reel |
| FSA3157L6X   | BB       | RoHS       | 6-Lead, MicroPak 1.0mm Wide Package          | 5000 Units on Tape and Reel |



For Fairchild's definition of "green" Eco Status, please visit: [http://www.fairchildsemi.com/company/green/rohs\\_green.html](http://www.fairchildsemi.com/company/green/rohs_green.html).

MicroPak™ is a trademark of Fairchild Semiconductor Corporation.

### Logic Symbol

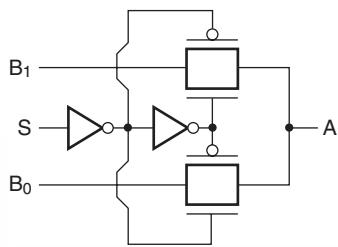


Figure 1. Logic Symbol

### Analog Symbol

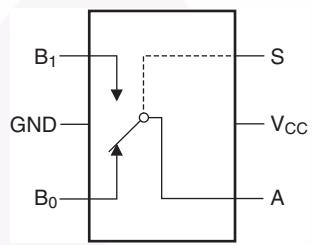
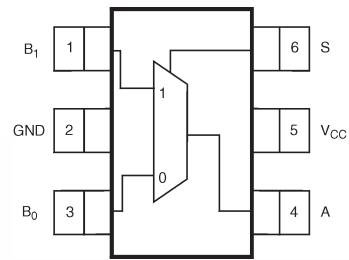


Figure 3. Analog Symbol

### Connection Diagrams



2. Pin Assignments SC70

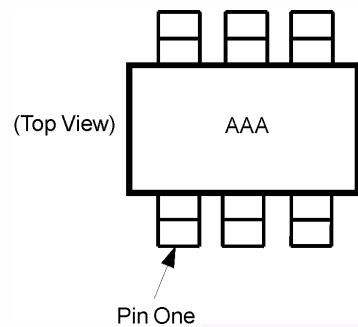


Figure 4. Pin One Orientation

### Function Table

| Input (S)        | Function                      |
|------------------|-------------------------------|
| Logic Level Low  | B <sub>0</sub> Connected to A |
| Logic Level High | B <sub>1</sub> Connected to A |

### Note:

Orientation of top mark determines pin one location. Read the top product code mark left to right and pin one is the lower left pin (see Figure 4).

### Pin Descriptions

| Pin Names                          | Description   |
|------------------------------------|---------------|
| A, B <sub>0</sub> , B <sub>1</sub> | Data Ports    |
| S                                  | Control Input |

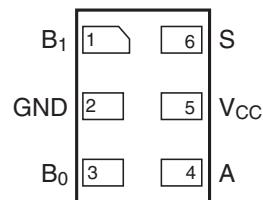


Figure 5. Pad Assignments for MicroPak™

## 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 | +7.0           | V     |
| $V_S$            | DC Switch Voltage <sup>(1)</sup>                  | -0.5 | $V_{CC} + 0.5$ | V     |
| $V_{IN}$         | DC Input Voltage <sup>(1)</sup>                   | -0.5 | +7.0           | V     |
| $I_{IK}$         | DC Input Diode Current at $V_{IN} < 0V$           |      | -50            | mA    |
| $I_{OUT}$        | DC Output Current                                 |      | 128            | mA    |
| $I_{CC}/I_{GND}$ | DC $V_{CC}$ or Ground Current                     |      | $\pm 100$      | mA    |
| $T_{STG}$        | Storage Temperature Range                         | -65  | +150           | °C    |
| $T_J$            | Junction Temperature Under Bias                   |      | +150           | °C    |
| $T_L$            | Junction Lead Temperature (Soldering, 10 seconds) |      | +260           | °C    |
| MSL              | Moisture Sensitivity Level (JEDEC J-STD-020A)     |      | 1              | Level |
| $P_D$            | Power Dissipation at +85°C                        |      | 180            | mW    |
| ESD              | Human Body Model, JESD22-A114                     |      | 4000           | 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.     | Unit |      |
|---------------|--------------------------------------|---|----------|------|------|
| $V_{CC}$      | Supply Voltage Operating             | 1.65  | 5.50     | V    |      |
| $V_{IN}$      | Control Input Voltage <sup>(2)</sup> | 0   | $V_{CC}$ | V    |      |
| $V_{IN}$      | Switch Input Voltage <sup>(2)</sup>  | 0   | $V_{CC}$ | V    |      |
| $V_{OUT}$     | Output Voltage <sup>(2)</sup>        | 0   | $V_{CC}$ | V    |      |
| $T_A$         | Operating Temperature                | -40   | +85      | °C   |      |
| $t_r, t_f$    | Input Rise and Fall Time             | Control Input<br>$V_{CC} = 2.3V\text{--}3.6V$ | 0        | 10   | ns/V |
|               |                                      | Control Input<br>$V_{CC} = 4.5V\text{--}5.5V$ | 0        | 5    | ns/V |
| $\theta_{JA}$ | Thermal Resistance, SC70             |   | 270      | °C/W |      |

**Note:**

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

## DC Electrical Characteristics

| Symbol             | Parameter   | Conditions  | V <sub>CC</sub> (V) | T <sub>A</sub> = +25°C |       |                      | T <sub>A</sub> = -40°C to +85°C |                      | Units |
|--------------------|---|---|---------------------|------------------------|-------|----------------------|---------------------------------|----------------------|-------|
|                    |   |   |                     | Min.                   | Typ.  | Max.                 | Min.                            | Max.                 |       |
| V <sub>IH</sub>    | High Level Input Voltage                                  |   | 1.65 – 1.95         | 0.75 V <sub>CC</sub>   |       |                      | 0.75 V <sub>CC</sub>            |                      | V     |
|                    |   |   | 2.3 – 5.5           | 0.7 V <sub>CC</sub>    |       |                      | 0.7 V <sub>CC</sub>             |                      |       |
| V <sub>IL</sub>    | Low Level Input Voltage                                   |   | 1.65 – 1.95         |                        |       | 0.25 V <sub>CC</sub> |                                 | 0.25 V <sub>CC</sub> | V     |
|                    |   |   | 2.3 – 5.5           |                        |       | 0.3 V <sub>CC</sub>  |                                 | 0.3 V <sub>CC</sub>  |       |
| I <sub>IN</sub>    | Input Leakage Current                                     | 0 ≤ V <sub>IN</sub> ≤ 5.5V                                    | 0 – 5.5             |                        | ±0.05 | ±0.1                 |                                 | ±1                   | µA    |
| I <sub>OFF</sub>   | Off State Leakage Current                                 | 0 ≤ A, B ≤ V <sub>CC</sub>                                    | 1.65 – 5.5          |                        | ±0.05 | ±0.1                 |                                 | ±1                   | µA    |
| R <sub>ON</sub>    | Switch On Resistance <sup>(3)</sup>                       | V <sub>IN</sub> = 0V, I <sub>O</sub> = 30mA                   | 4.5                 |                        | 3.0   | 7.0                  |                                 | 7.0                  | Ω     |
|                    |   | V <sub>IN</sub> = 2.4V, I <sub>O</sub> = -30mA                |                     |                        | 5.0   | 12.0                 |                                 | 12.0                 |       |
|                    |   | V <sub>IN</sub> = 4.5V, I <sub>O</sub> = -30mA                |                     |                        | 7.0   | 15.0                 |                                 | 15.0                 |       |
|                    |   | V <sub>IN</sub> = 0V, I <sub>O</sub> = 24mA                   | 3.0                 |                        | 4.0   | 9.0                  |                                 | 9.0                  |       |
|                    |   | V <sub>IN</sub> = 3V, I <sub>O</sub> = -24mA                  |                     |                        | 10.0  | 20.0                 |                                 | 20.0                 |       |
|                    |   | V <sub>IN</sub> = 0V, I <sub>O</sub> = 8mA                    | 2.3                 |                        | 5.0   | 12.0                 |                                 | 12.0                 |       |
|                    |   | V <sub>IN</sub> = 2.3V, I <sub>O</sub> = -8mA                 |                     |                        | 13.0  | 30.0                 |                                 | 30.0                 |       |
|                    |   | V <sub>IN</sub> = 0V, I <sub>O</sub> = 4mA                    | 1.65                |                        | 6.5   | 20.0                 |                                 | 20.0                 |       |
|                    |   | V <sub>IN</sub> = 1.65V, I <sub>O</sub> = -4mA                |                     |                        | 17.0  | 50.0                 |                                 | 50.0                 |       |
| I <sub>CC</sub>    | Quiescent Supply Current; All Channels On or Off          | V <sub>IN</sub> = V <sub>CC</sub> or GND I <sub>OUT</sub> = 0 | 5.5                 |                        |       | 1                    |                                 | 10                   | µA    |
|                    | Analog Signal Range                                       |   | V <sub>CC</sub>     | 0                      |       | V <sub>CC</sub>      | 0                               | V <sub>CC</sub>      | V     |
| R <sub>RANGE</sub> | On Resistance Over Signal Range <sup>(3, 7)</sup>         | I <sub>A</sub> = -30mA, 0 ≤ V <sub>Bn</sub> ≤ V <sub>CC</sub> | 4.5                 |                        |       |                      |                                 | 25.0                 | Ω     |
|                    |   | I <sub>A</sub> = -24mA, 0 ≤ V <sub>Bn</sub> ≤ V <sub>CC</sub> | 3.0                 |                        |       |                      |                                 | 50.0                 |       |
|                    |   | I <sub>A</sub> = -8mA, 0 ≤ V <sub>Bn</sub> ≤ V <sub>CC</sub>  | 2.3                 |                        |       |                      |                                 | 100                  |       |
|                    |   | I <sub>A</sub> = -4mA, 0 ≤ V <sub>Bn</sub> ≤ V <sub>CC</sub>  | 1.65                |                        |       |                      |                                 | 300                  |       |
| ΔR <sub>ON</sub>   | On Resistance Match Between-Channels <sup>(3, 4, 5)</sup> | I <sub>A</sub> = -30mA, V <sub>Bn</sub> = 3.15                | 4.5                 |                        | 0.15  |                      |                                 |                      | Ω     |
|                    |   | I <sub>A</sub> = -24mA, V <sub>Bn</sub> = 2.1                 | 3.0                 |                        | 0.2   |                      |                                 |                      |       |
|                    |   | I <sub>A</sub> = -8mA, V <sub>Bn</sub> = 1.6                  | 2.3                 |                        | 0.5   |                      |                                 |                      |       |
|                    |   | I <sub>A</sub> = -4mA, V <sub>Bn</sub> = 1.15                 | 1.65                |                        | 0.50  |                      |                                 |                      |       |
| R <sub>flat</sub>  | On Resistance Flatness <sup>(3, 4, 6)</sup>               | I <sub>A</sub> = -30mA, 0 ≤ V <sub>Bn</sub> ≤ V <sub>CC</sub> | 5.0                 |                        | 6.0   |                      |                                 |                      | Ω     |
|                    |   | I <sub>A</sub> = -24mA, 0 ≤ V <sub>Bn</sub> ≤ V <sub>CC</sub> | 3.3                 |                        | 12.0  |                      |                                 |                      |       |
|                    |   | I <sub>A</sub> = -8mA, 0 ≤ V <sub>Bn</sub> ≤ V <sub>CC</sub>  | 2.5                 |                        | 28.0  |                      |                                 |                      |       |
|                    |   | I <sub>A</sub> = -4mA, 0 ≤ V <sub>Bn</sub> ≤ V <sub>CC</sub>  | 1.8                 |                        | 125   |                      |                                 |                      |       |

## Notes:

- Measured by the voltage drop between A and B pins at the indicated current through the switch. On resistance is determined by the lower of the voltages on the two (A or B Ports).
- Parameter is characterized, but not tested in production.
- $\Delta R_{ON} = R_{ON \ max} - R_{ON \ min}$  measured at identical V<sub>CC</sub>, temperature, and voltage levels.
- Flatness is defined as the difference between the maximum and minimum value of on resistance over the specified range of conditions.
- Guaranteed by design.

## AC Electrical Characteristics

| Symbol                                 | Parameter  | Conditions  | V <sub>CC</sub><br>(V) | T <sub>A</sub> = +25°C |       |      | T <sub>A</sub> = -40°C to<br>+85°C |      | Units | Figure<br>Number       |
|--|--|---|------------------------|------------------------|-------|------|------------------------------------|------|-------|------------------------|
|  |  |   |                        | Min.                   | Typ.  | Max. | Min.                               | Max. |       |                        |
| t <sub>PHL</sub> ,<br>t <sub>PLH</sub> | Propagation Delay<br>Bus-to-Bus <sup>(8)</sup>               | V <sub>I</sub> = OPEN   | 1.65 – 1.95            |                        |       | 3.5  |                                    | 3.5  | ns    | Figure 12<br>Figure 13 |
|  |  |   | 2.3 – 2.7              |                        |       | 1.2  |                                    | 1.2  |       |                        |
|  |  |   | 3.0 – 3.6              |                        |       | 0.8  |                                    | 0.8  |       |                        |
|  |  |   | 4.5 – 5.5              |                        |       | 0.3  |                                    | 0.3  |       |                        |
| t <sub>PZL</sub> ,<br>t <sub>PZH</sub> | Output Enable Time<br>Turn-On Time<br>(A to B <sub>n</sub> ) | V <sub>I</sub> = 2 x V <sub>CC</sub> for t <sub>PZL</sub><br>V <sub>I</sub> = 0V for t <sub>PZH</sub> | 1.65 – 1.95            | 7.0                    |       | 23.0 | 7.0                                | 24.0 | ns    | Figure 12<br>Figure 13 |
|  |  |   | 2.3 – 2.7              | 3.5                    |       | 13.0 | 3.5                                | 14.0 |       |                        |
|  |  |   | 3.0 – 3.6              | 2.5                    |       | 6.9  | 2.5                                | 7.6  |       |                        |
|  |  |   | 4.5 – 5.5              | 1.7                    |       | 5.2  | 1.7                                | 5.7  |       |                        |
| t <sub>PLZ</sub> ,<br>t <sub>PHZ</sub> | Output Disable Time<br>Turn-Off Time<br>(A Port to B Port)   | V <sub>I</sub> = 2 x V <sub>CC</sub> for t <sub>PLZ</sub><br>V <sub>I</sub> = 0V for t <sub>PHZ</sub> | 1.65 – 1.95            | 3.0                    |       | 12.5 | 3.0                                | 13.0 | ns    | Figure 12<br>Figure 13 |
|  |  |   | 2.3 – 2.7              | 2.0                    |       | 7.0  | 2.0                                | 7.5  |       |                        |
|  |  |   | 3.0 – 3.6              | 1.5                    |       | 5.0  | 1.5                                | 5.3  |       |                        |
|  |  |   | 4.5 – 5.5              | 0.8                    |       | 3.5  | 0.8                                | 3.8  |       |                        |
| t <sub>B-M</sub>                       | Break-Before-Make<br>Time <sup>(9)</sup>                     |   | 1.65 – 1.95            | 0.5                    |       |      | 0.5                                |      | ns    | Figure 14              |
|  |  |   | 2.3 – 2.7              | 0.5                    |       |      | 0.5                                |      |       |                        |
|  |  |   | 3.0 – 3.6              | 0.5                    |       |      | 0.5                                |      |       |                        |
|  |  |   | 4.5 – 5.5              | 0.5                    |       |      | 0.5                                |      |       |                        |
| Q                                      | Charge Injection <sup>(9)</sup>                              | C <sub>L</sub> = 0.1nF, V <sub>GEN</sub> = 0V,  | 5.0                    |                        | 7.0   |      |                                    |      | pC    | Figure 15              |
|  |  | R <sub>GEN</sub> = 0Ω   | 3.3                    |                        | 3.0   |      |                                    |      |       |                        |
| OIRR                                   | Off Isolation <sup>(10)</sup>                                | R <sub>L</sub> = 50Ω, f = 10MHz   | 1.65 – 5.5             |                        | -57.0 |      |                                    |      | dB    | Figure 16              |
| Xtalk                                  | Crosstalk  | R <sub>L</sub> = 50Ω, f = 10MHz   | 1.65 – 5.5             |                        | -54.0 |      |                                    |      | dB    | Figure 17              |
| BW                                     | -3dB Bandwidth   | R <sub>L</sub> = 50Ω  | 1.65 – 5.5             |                        | 250   |      |                                    |      | MHz   | Figure 20              |
| THD                                    | Total Harmonic<br>Distortion <sup>(9)</sup>                  | R <sub>L</sub> = 600Ω, 0.5 V <sub>PP</sub> ,<br>f = 600 Hz to 20 KHz                                  | 5.0                    |                        | .011  |      |                                    |      | %     |                        |

## Notes:

- This parameter is guaranteed by design but not tested. The bus switch contributes no propagation delay other than the RC delay of the on resistance of the switch and the 50pF load capacitance, when driven by an ideal voltage source (zero output impedance).
- Guaranteed by design.
- Off Isolation =  $20 \log_{10} [V_A / V_{Bn}]$ .

## Capacitance

T<sub>A</sub> = +25°C, f = 1MHz. Capacitance is characterized, but not tested in production.

| Symbol              | Parameter                                 | Conditions             | Typ. | Max. | Units | Figure<br>Number |
|---------------------|---|------------------------|------|------|-------|------------------|
| C <sub>IN</sub>     | Control Pin Input Capacitance             | V <sub>CC</sub> = 0V   | 2.3  |      | pF    |                  |
| C <sub>IO-B</sub>   | B Port Off Capacitance                    | V <sub>CC</sub> = 5.0V | 6.5  |      | pF    | Figure 18        |
| C <sub>IOA-ON</sub> | A Port Capacitance When Switch Is Enabled | V <sub>CC</sub> = 5.0V | 18.5 |      | pF    | Figure 19        |

## Typical Characteristics

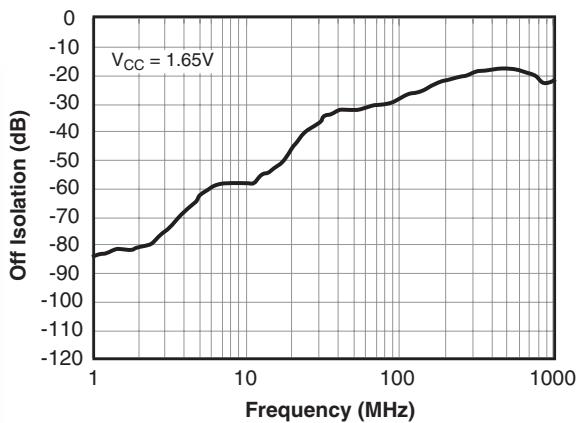


Figure 6. Off Isolation,  $V_{CC} = 1.65V$

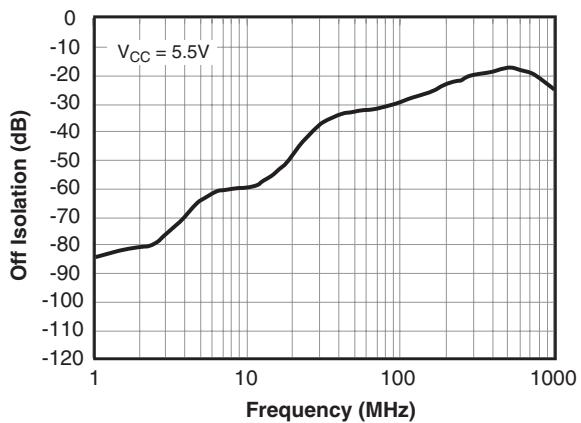


Figure 7. Off Isolation,  $V_{CC} = 5.5V$

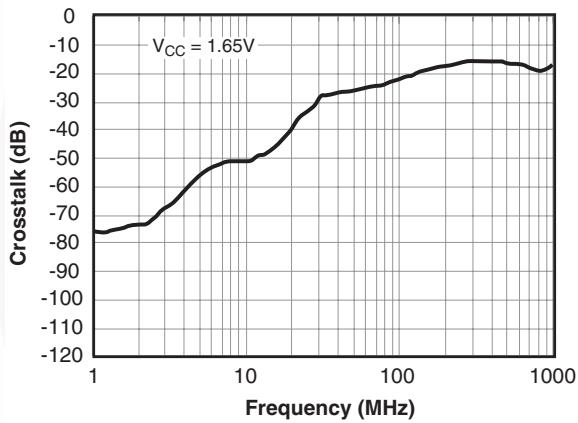


Figure 8. Crosstalk,  $V_{CC} = 1.65V$

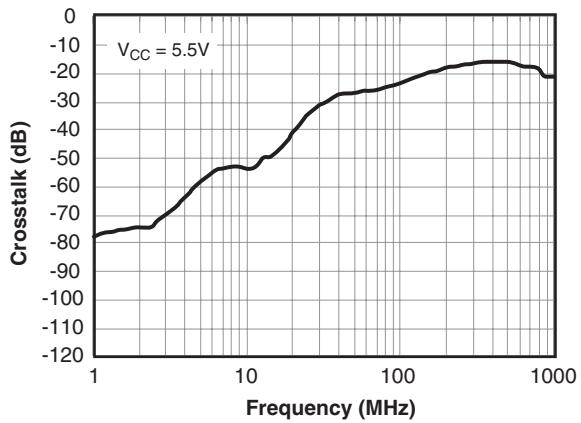


Figure 9. Crosstalk,  $V_{CC} = 5.5V$

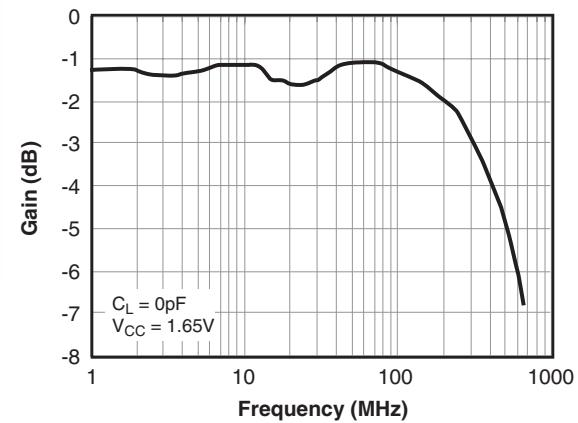


Figure 10. Bandwidth,  $V_{CC} = 1.65V$

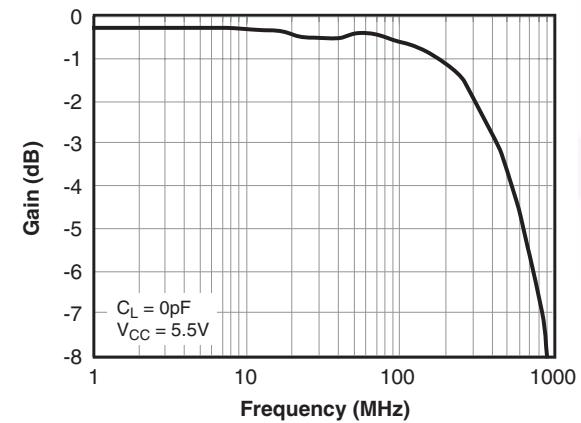
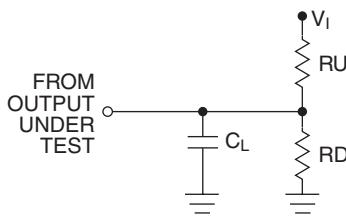


Figure 11. Bandwidth,  $V_{CC} = 5.5V$

## AC Loading and Waveforms



### Notes:

Input driven by  $50\Omega$  source terminated in  $50\Omega$   
 $C_L$  includes load and stray capacitance  
 Input PRR = 1.0 MHz;  $t_W$  = 500 ns

Figure 12. AC Test Circuit

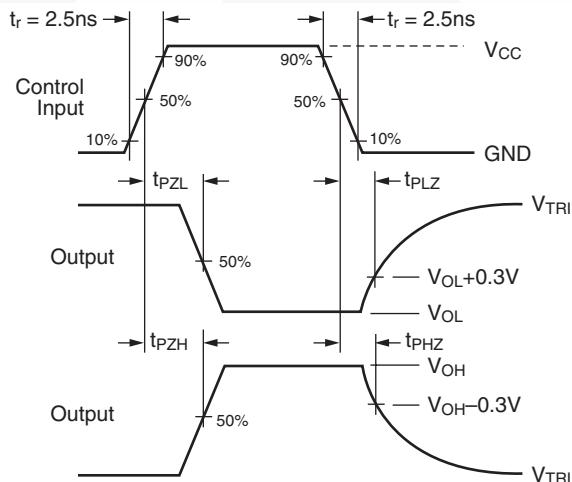
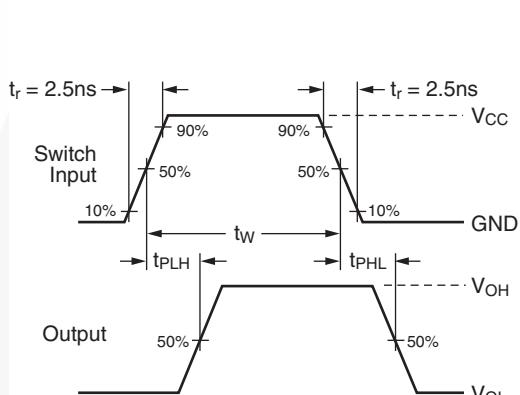


Figure 13. AC Waveforms

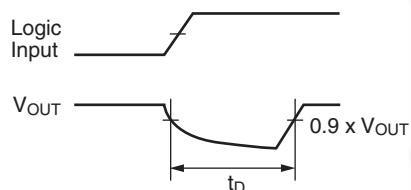
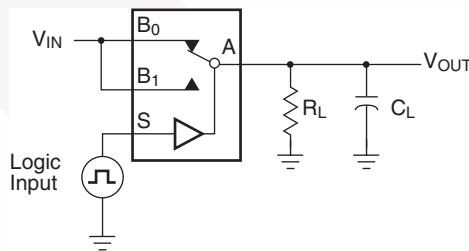


Figure 14. Break-Before-Make Interval Timing

### AC Loading and Waveforms (continued)

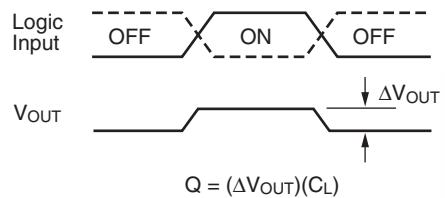
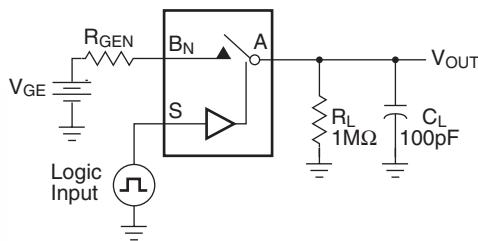


Figure 15. Charge Injection Test

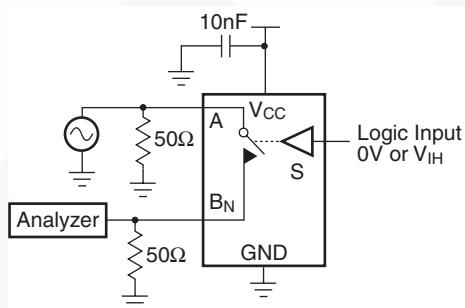


Figure 16. Off Isolation

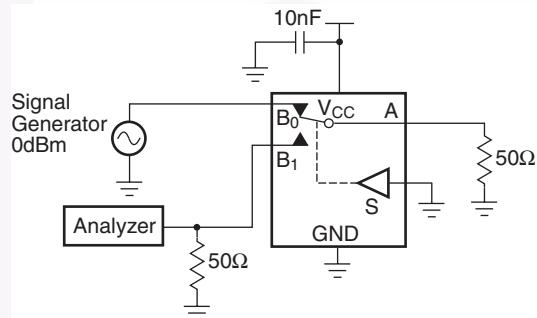


Figure 17. Crosstalk

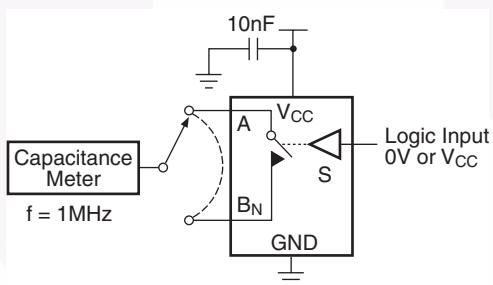


Figure 18. Channel Off Capacitance

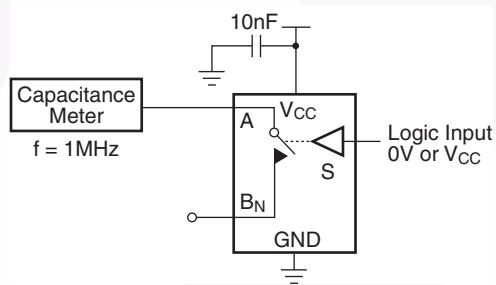


Figure 19. Channel On Capacitance

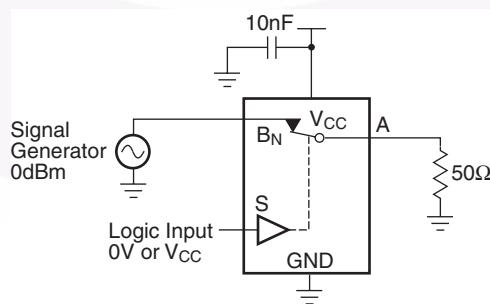


Figure 20. Bandwidth

## Physical Dimensions

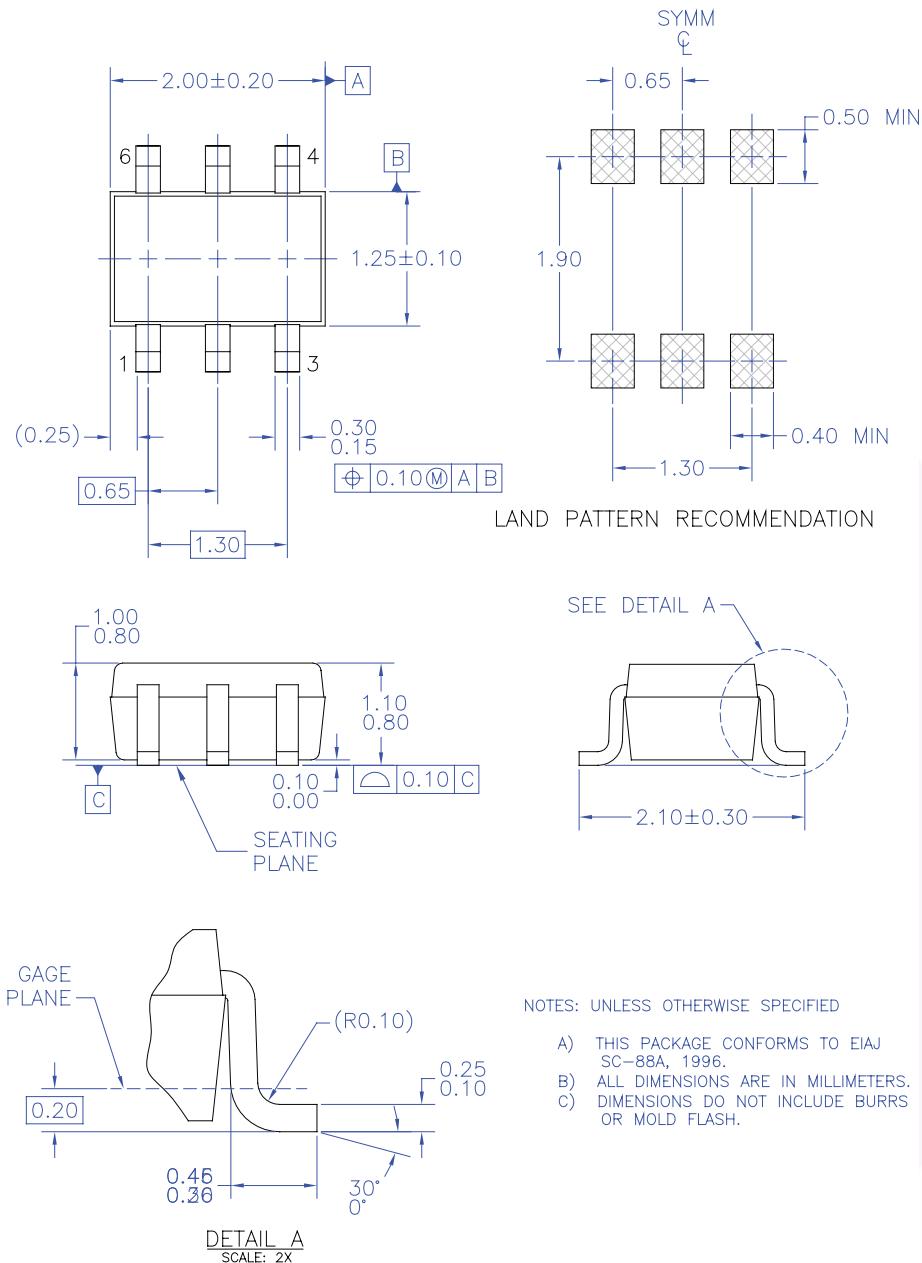


Figure 21. 6-Lead, SC70, EIAJ SC88, 1.25mm Wide Package

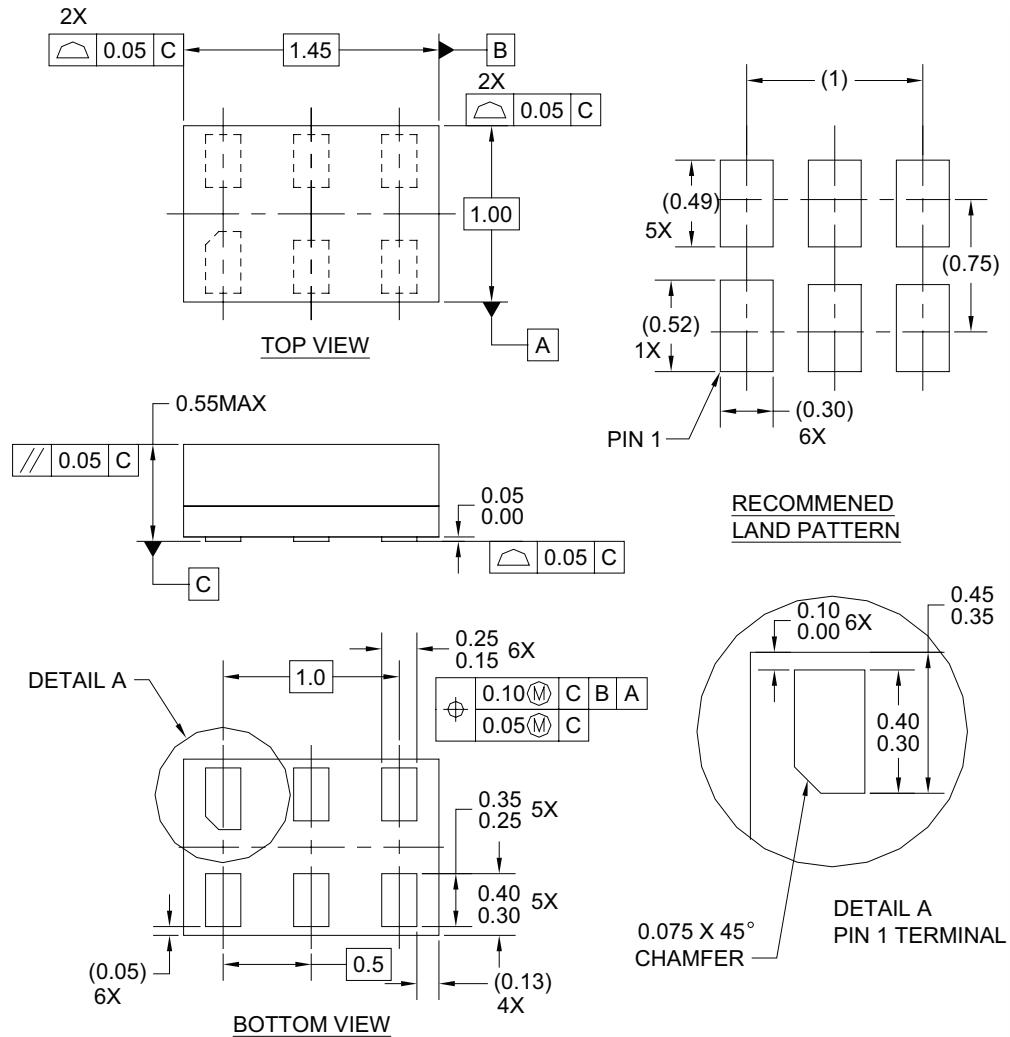
Note: click here for tape and reel specifications, available at:  
[http://www.fairchildsemi.com/products/analog/pdf/sc70-6\\_tr.pdf](http://www.fairchildsemi.com/products/analog/pdf/sc70-6_tr.pdf)

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## Physical Dimensions



## Notes:

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

MAC06AREVC

## 6-Lead, MicroPak™ 1.0mm Wide Package

[Note: click here for tape and reel specifications, available at:](#)  
[http://www.fairchildsemi.com/products/logic/pdf/micropak\\_tr.pdf](http://www.fairchildsemi.com/products/logic/pdf/micropak_tr.pdf)

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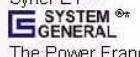


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|--------------------------|-----------------------|---|
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