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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

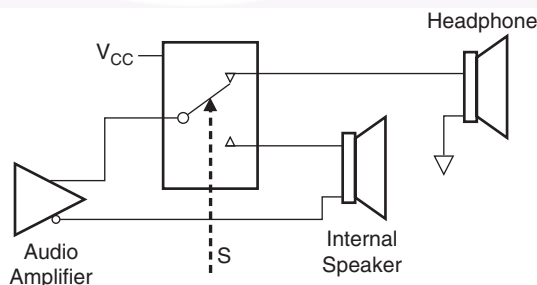


Figure 1. Application Diagram

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Pin Assignments

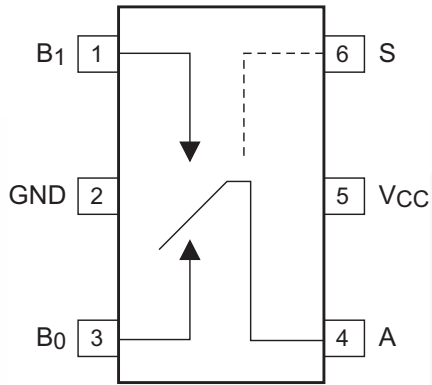


Figure 2. 6-Lead SC70

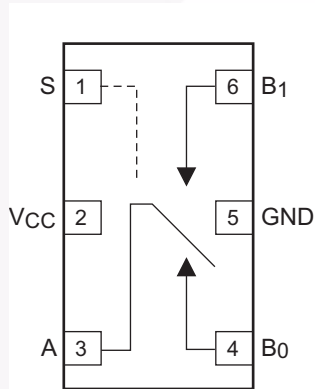


Figure 3. 6-Lead MicroPak™

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 | |
| ΔR _{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:

- On resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.
- ΔR_{ON} = R_{ONmax} - R_{ONmin} measured at identical V_{CC}, temperature, and voltage.
- 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 | R _L = 32Ω, V _{IN} = 2V _{PP} , f = 20Hz to 20kHz | 3.6 to 4.3 | | | | | | % | Figure 14 |
| | | | 2.7 to 3.6 | | 0.02 | | | | | |
| | | | 2.3 to 2.7 | | 0.036 | | | | | |
| | | | 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

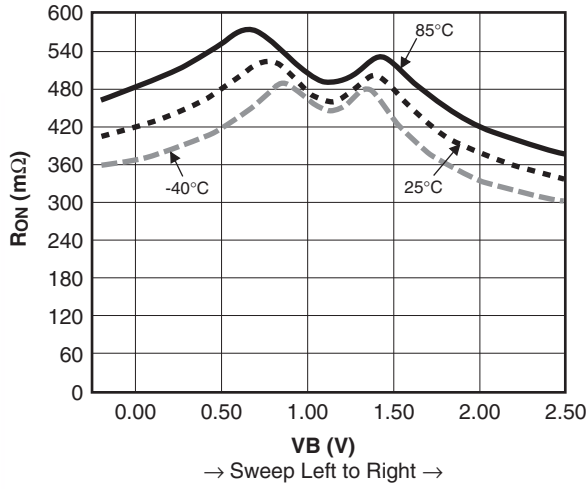


Figure 4. R_{ON} Switch On Resistance, $I_{ON} = 100\text{mA}$, $V_{CC} = 2.3\text{V B0}$

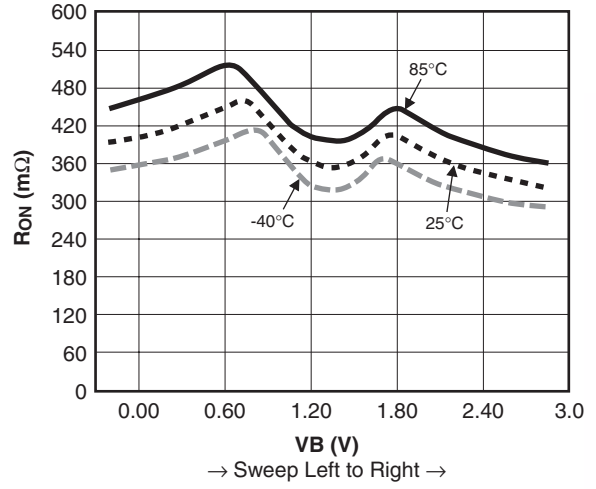


Figure 5. R_{ON} Switch On Resistance, $I_{ON} = 100\text{mA}$, $V_{CC} = 2.7\text{V B0}$

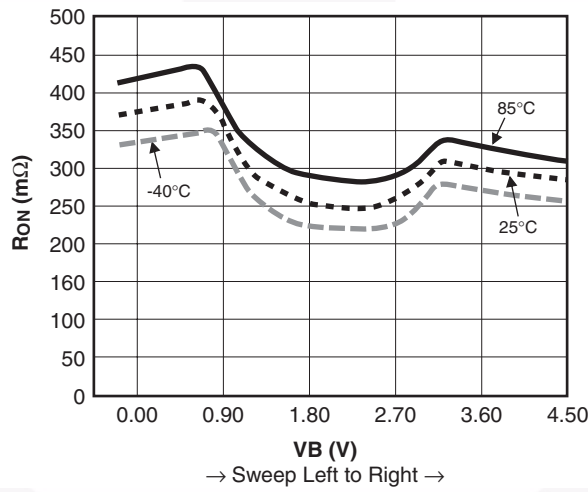
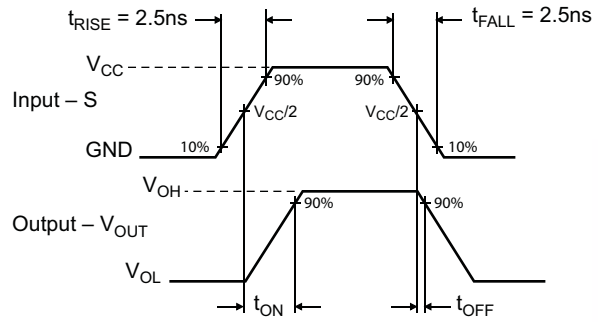
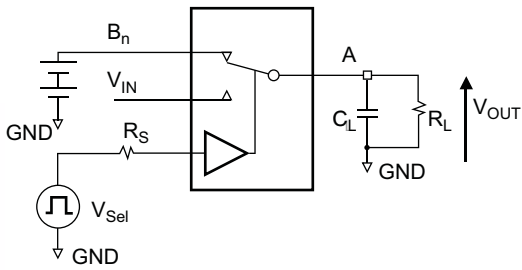


Figure 6. R_{ON} Switch On Resistance, $I_{ON} = 100\text{mA}$, $V_{CC} = 4.3\text{V B0}$



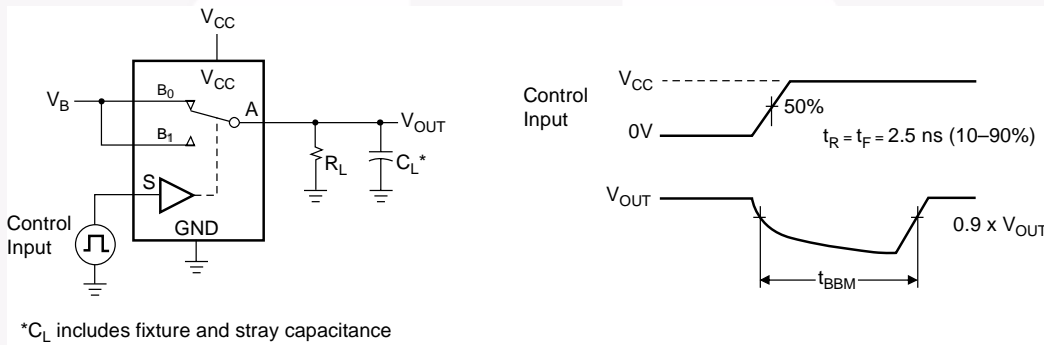
AC Loading and Waveforms



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

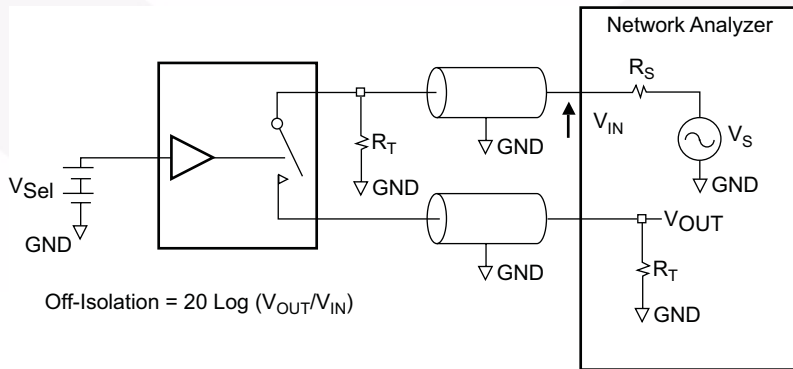


Figure 9. Off Isolation

AC Loading and Waveforms (continued)

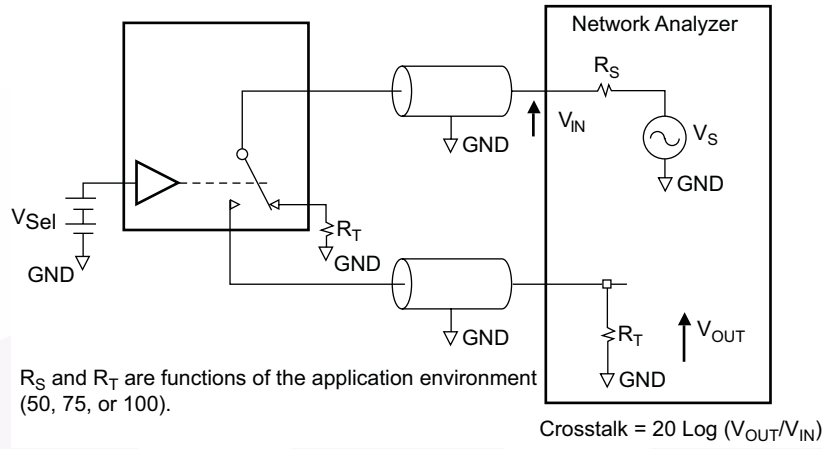


Figure 10. Non-Adjacent Channel-to-Channel Crosstalk

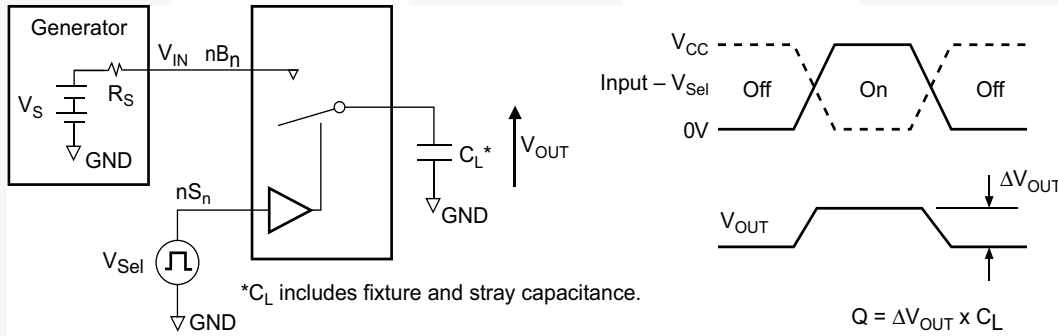


Figure 11. Charge Injection Test

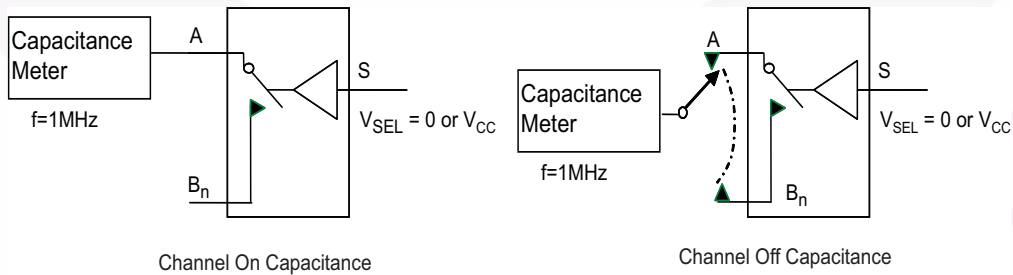


Figure 12. On/Off Capacitance Measurement Setup

AC Loading and Waveforms (continued)

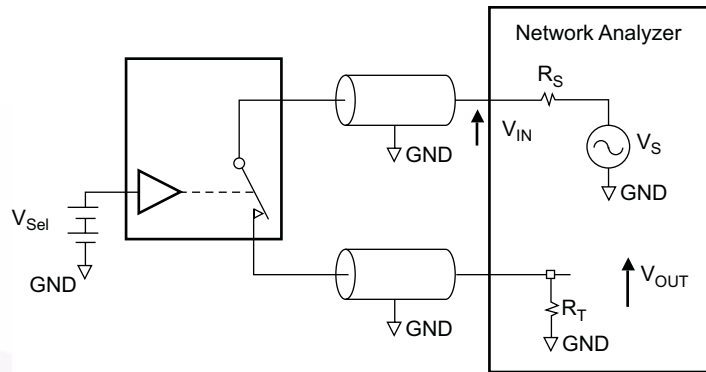


Figure 13. Bandwidth

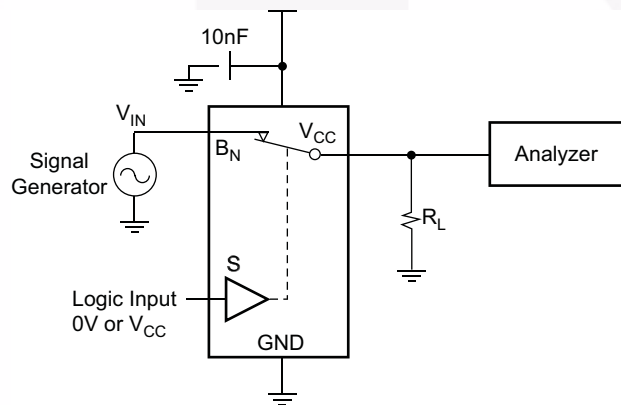
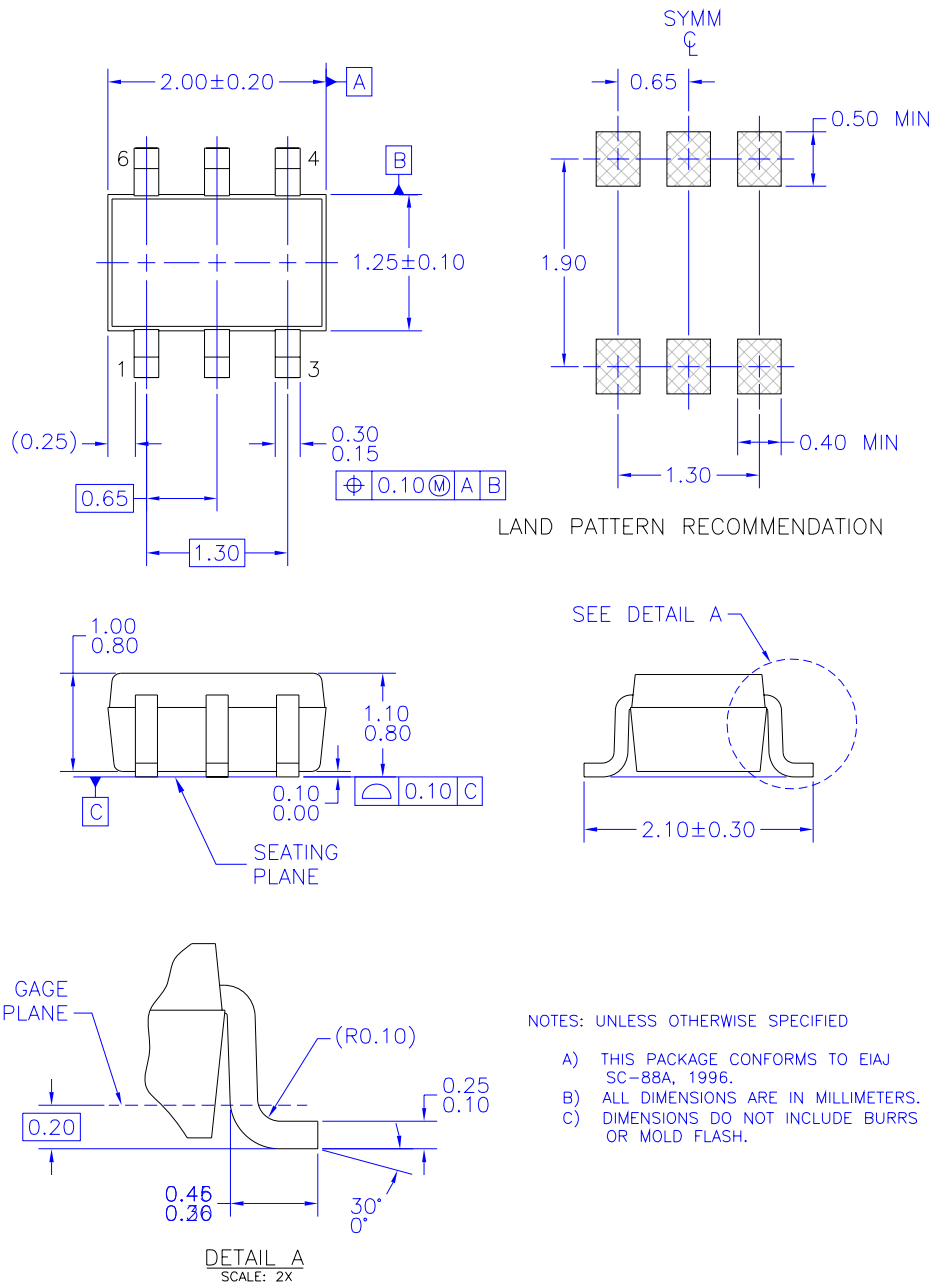


Figure 14. Harmonic Distortion



Physical Dimensions



MAA06AREV5

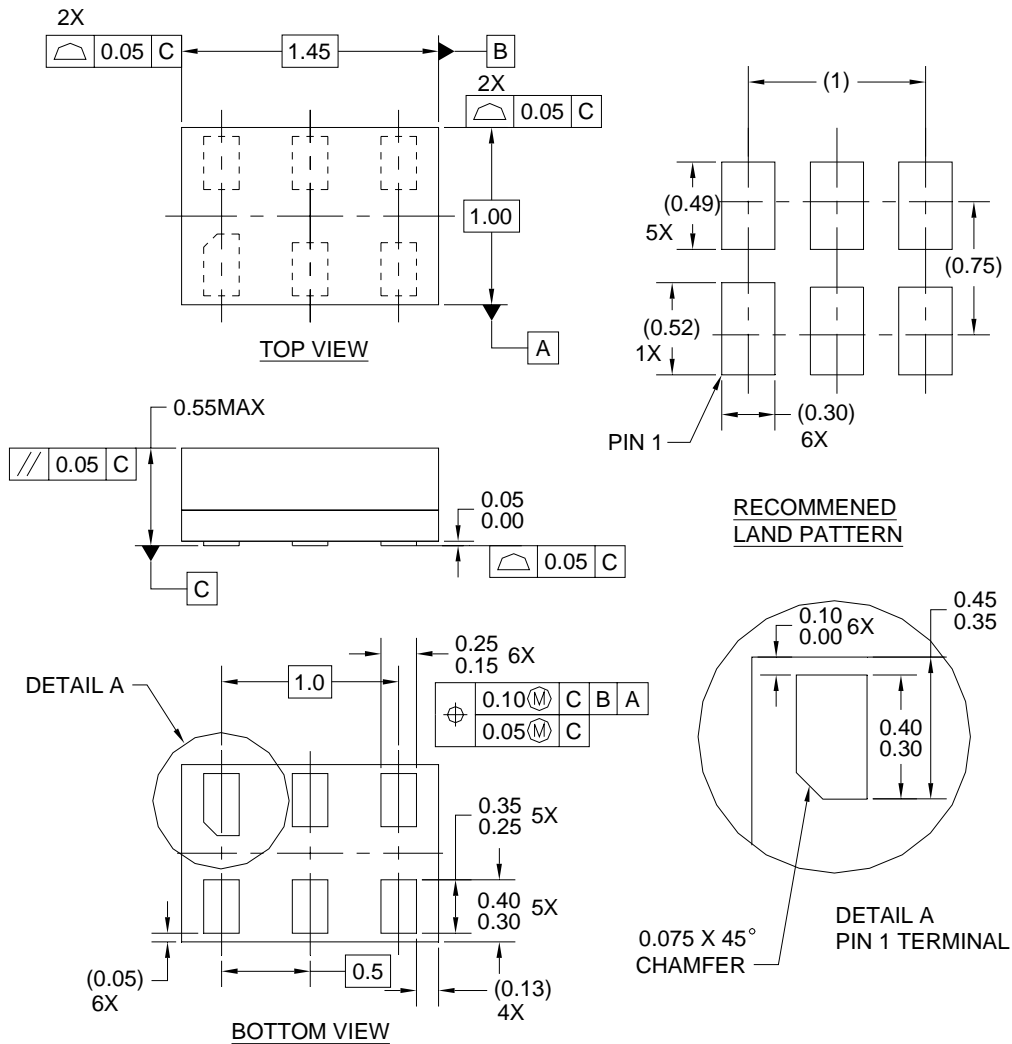
Figure 15. 6-Lead SC70, EIAJ SC88, 1.25mm Wide

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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

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

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