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FSA4157, FSA4157A

Low-Voltage, 1 Ω SPDT Analog Switch

Features

- FSA4157A Features Lower I_{CC} when the S Input is Lower Than V_{CC}
- Maximum 1.15 Ω On Resistance (R_{ON}) at 4.5 V V_{CC}
- 0.3 Ω Maximum R_{ON} Flatness at 4.5 V V_{CC}
- Space-Saving 6-lead, MicroPak™ and SC70 6 Packages
- Broad V_{CC} Operating Range:
 - FSA4157: 1.65 V to 5.5 V
 - FSA4157A: 2.7 V to 5.5 V
- Fast Turn-On and Turn-Off Time
- Break-Before-Make Enable Circuitry
- Over-Voltage Tolerant TTL-Compatible Control Circuitry

Description

FSA4157 and FSA4157A are high performance Single Pole/Double Throw (SPDT) analog switches. Both devices feature ultra low R_{ON} of 1.15 Ω maximum at 4.5 V V_{CC} and operates over the wide V_{CC} range of 1.65 V to 5.5 V for FSA4157, and 2.7 V to 5.5 V for FSA4157A. The device is fabricated with sub-micron CMOS technology to achieve fast switching speeds and is designed for break-before-make operation. The select input is TTL level compatible.

The FSA4157A features very low quiescent current even when the control voltage is lower than the V_{CC} supply. This feature services the mobile handset applications very well allowing for the direct interface with baseband processor general purpose I/Os.

Ordering Information

| Part Number | Top Mark | Package Description | Packing Method |
|-------------|----------|--------------------------------------|--------------------------|
| FSA4157P6X | A57 | 6-Lead SC70, EIAJ SC88, 1.25 mm Wide | 3000 Units Tape and Reel |
| FSA4157L6X | EG | 6-Lead MicroPak,™ 1.0 mm Wide | 5000 Units Tape and Reel |
| FSA4157AP6X | B57 | 6-Lead SC70, EIAJ SC88, 1.25 mm Wide | 3000 Units Tape and Reel |
| FSA4157AL6X | EU | 6-Lead MicroPak™, 1.0 mm Wide | 5000 Units Tape and Reel |

Pin Configurations

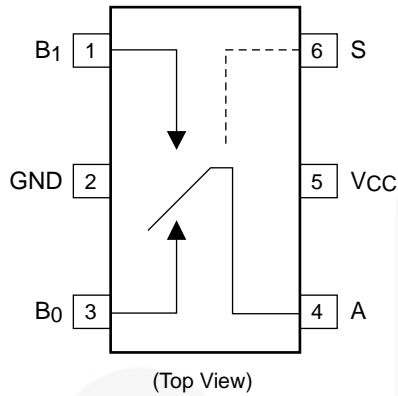


Figure 1. SC70 Pin Assignments

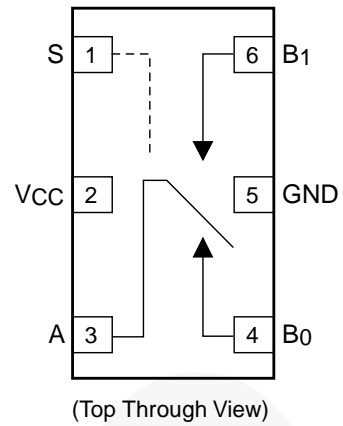


Figure 2. MicroPak™ Pin Assignments

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

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 | 6.0 | V |
| V _S | DC Switch Voltage ⁽¹⁾ | | -0.5 | V _{CC} + 0.5 | V |
| V _{IN} | DC Input Voltage ⁽¹⁾ | | -0.5 | 6.0 | V |
| I _{IK} | DC Input Diode Current | | -50 | | mA |
| I _{SW} | Switch Current | | | 200 | mA |
| I _{SWPEAK} | Peak Switch Current (Pulse at 1 ms duration, <10% Duty Cycle) | | | 400 | mA |
| P _D | Power Dissipation at 85°C | SC70 | | 180 | mW |
| | | MicroPak™ | | | |
| 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, JESD22-A114 (FSA4157A) | | 7500 | V |

Note:

- Input and output negative ratings may be exceeded if 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 | FSA4157 | 1.65 | 5.50 | V |
| | | FSA4157A | 2.7 | 5.5 | |
| V _{CNTRL} | 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 in Still Air | SC70 | | 350 | °C/W |
| | | MicroPak™ (Estimated) | | 330 | |

Note:

- Control input must be held HIGH or LOW and it must not float.

DC Electrical Characteristics

Typical values are at 25°C unless otherwise specified.

| Symbol | Parameter | Conditions | V _{CC} (V) | Ambient Temperature | | | | | Unit |
|--|--|--|---------------------|---------------------|------|------|--------------|------|------|
| | | | | -25° | | | -40 to +85°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | |
| V _{IH} | Input Voltage High | FSA4157 Only | 1.8 to 2.7 | | | | 1.0 | | V |
| | | | 2.7 to 3.6 | | | | 2.0 | | |
| | | | 4.5 to 5.5 | | | | 2.4 | | |
| V _{IL} | Input Voltage Low | FSA4157 Only | 1.8 to 2.7 | | | | | 0.4 | V |
| | | FSA4157A Only | 2.7 to 3.6 | | | | | 0.4 | |
| | | | 2.7 to 3.6 | | | | | 0.6 | |
| | | | 4.5 to 5.5 | | | | | 0.8 | |
| I _{IN} | Control Input Leakage | V _{IN} =0 V to V _{CC} | 2.7 to 3.6 | | | | -1.0 | 1.0 | μA |
| | | | 4.5 to 5.5 | | | | -1.0 | 1.0 | |
| I _{NO(OFF)} , I _{NC(OFF)} | Off Leakage Current of Port B0 and B1 | A=1 V, 4.5 V, B ₀ or B ₁ =4.5, 1 V | 5.5 | | ±2 | | -20 | 20 | nA |
| I _{A(ON)} | On Leakage Current of Port A | A=1 V, 4.5V, B ₀ or B ₁ =4.5, 1 V, 4.5 V or Floating | 5.5 | | ±4 | | -40 | 40 | nA |
| R _{ON} | Switch On Resistance | I _{OUT} =100 mA, B ₀ or B ₁ =1.5 V | 2.7 | | 2.6 | 4.0 | | 4.3 | Ω |
| | | I _{OUT} =100mA, B ₀ or B ₁ =3.5V | 4.5 | | 0.95 | 1.15 | | 1.30 | |
| ΔR _{ON} | On Resistance Matching Between Channels ⁽⁴⁾ | I _{OUT} =100 mA, B ₀ or B ₁ =1.5 V | 4.5 | | 0.06 | 0.12 | | 0.15 | Ω |
| R _{FLAT(ON)} | On Resistance Flatness ⁽⁴⁾ | I _{OUT} =100 mA, B ₀ or B ₁ =0 V, 0.75 V, 1.5 V | 2.7 | | 1.4 | | | | Ω |
| | | I _{OUT} =100 mA, B ₀ or B ₁ =0 V, 1 V, 2 V | 4.5 | | 0.2 | 0.3 | | 0.4 | |
| I _{CC} | Quiescent Supply Current | V _{IN} =0 V or V _{CC} , I _{OUT} =0 V | 3.6 | | 0.1 | 0.5 | | 1.0 | μA |
| | | | 5.5 | | 0.1 | 0.5 | | 1.0 | |
| ΔI _{CC} | Increase in I _{CC} per Input | One Input at 2.7 V, others at V _{CC} or GND (FSA4157A Only) | 4.3 | | 0.2 | | | 10.0 | μA |

Notes:

- Measured by the voltage drop between the A and B pins at the indicated current through the switch. On resistance is determined by the lower of the voltage on the two (A or B ports).
- ΔR_{ON} = R_{ON max} – R_{ON min} 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

Typical values are at 25°C unless otherwise specified.

| Symbol | Parameter | Conditions | V _{CC} (V) | Ambient Temperature | | | | | Unit | Figure |
|------------------|---------------------------|--|---------------------|---------------------|-------|------|--------------|------|-----------|----------|
| | | | | -25° | | | -40 to +85°C | | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | | |
| t _{ON} | Turn-On Time | B ₀ or B ₁ =1.5 V, R _L =50 Ω , C _L =35 pF (FSA4157A Only) | 2.7 to 3.6 | | | 60 | | 65 | ns | Figure 8 |
| | | B ₀ or B ₁ =1.5 V, R _L =50 Ω , C _L =35pF | 2.7 to 3.6 | | | 50 | | 60 | | |
| | | B ₀ or B ₁ =1.5 V, R _L =50 Ω , C _L =35pF | 4.5 to 5.5 | | | 35 | | 40 | | |
| t _{OFF} | Turn-Off Time | B ₀ or B ₁ =1.5 V, R _L =50 Ω , C _L =35 pF | 2.7 to 3.6 | | | 20 | | 30 | ns | Figure 8 |
| | | B ₀ or B ₁ =1.5 V, R _L =50 Ω , C _L =35 pF | 4.5 to 5.5 | | | 15 | | 20 | | |
| t _{BBM} | Break-Before-Make Time | FSA4157 | 2.7 to 3.6 | | | | | | ns | Figure 9 |
| | | | 4.5 to 5.5 | | 20 | | | | | |
| | | FSA4157A Only | 4.5 to 5.5 | | 25 | | | | | |
| Q | Charge Injection | C _L =1.0 nF, V _{GE} =0 V, R _{GEN} =0 Ω | 2.7 to 3.6 | | 10 | | | pC | Figure 11 | |
| | | | 4.5 to 5.5 | | 20 | | | | | |
| OIRR | Off Isolation | f=1 MHz, R _L =50 Ω | 2.7 to 3.6 | | -70 | | | dB | Figure 10 | |
| | | | 4.5 to 5.5 | | -70 | | | | | |
| Xtalk | Crosstalk | f=1 MHz, R _L =50 Ω | 2.7 to 3.6 | | -70 | | | dB | Figure 10 | |
| | | | 4.5 to 5.5 | | -70 | | | | | |
| BW | -3db Bandwidth | R _L =50 Ω | 2.7 to 3.6 | | | 300 | | MHz | Figure 13 | |
| | | | 4.5 to 5.5 | | | 300 | | | | |
| THD | Total Harmonic Distortion | R _L =600 Ω , V _{IN} =0.5, f=20 Hz to 20 kHz | 2.7 to 3.6 | | 0.002 | | | % | Figure 14 | |
| | | | 4.5 to 5.5 | | 0.002 | | | | | |

Capacitance

| Symbol | Parameter | Conditions | V _{CC} (V) | Ambient Temperature | | | Unit | Figure |
|------------------|-------------------------------|------------|---------------------|---------------------|------|------|------|-----------|
| | | | | -25° | | | | |
| | | | | Min. | Typ. | Max. | | |
| C _{IN} | Control Pin Input Capacitance | f=1 MHz | 0 | | 3.5 | | pF | Figure 12 |
| C _{OFF} | B Port Off Capacitance | f=1 MHz | 4.5 | | 12.0 | | pF | Figure 12 |
| C _{ON} | On Capacitance | f=1 MHz | 4.5 | | 40.0 | | pF | Figure 12 |

Typical Performance Characteristics

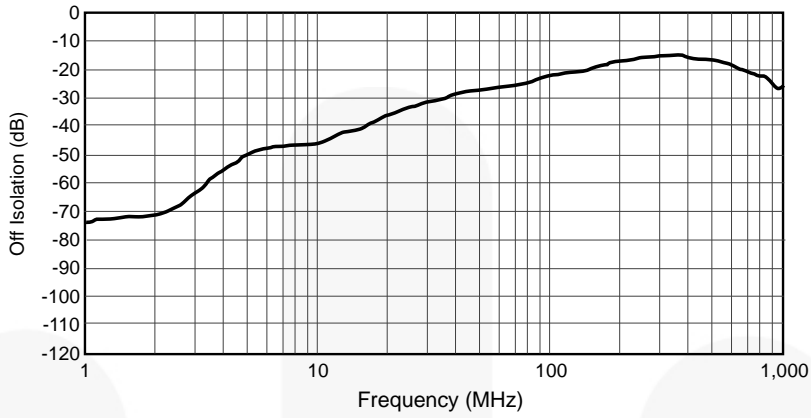


Figure 3. Off Isolation, $V_{CC} = 2.7\text{ V to }5.5\text{ V}$

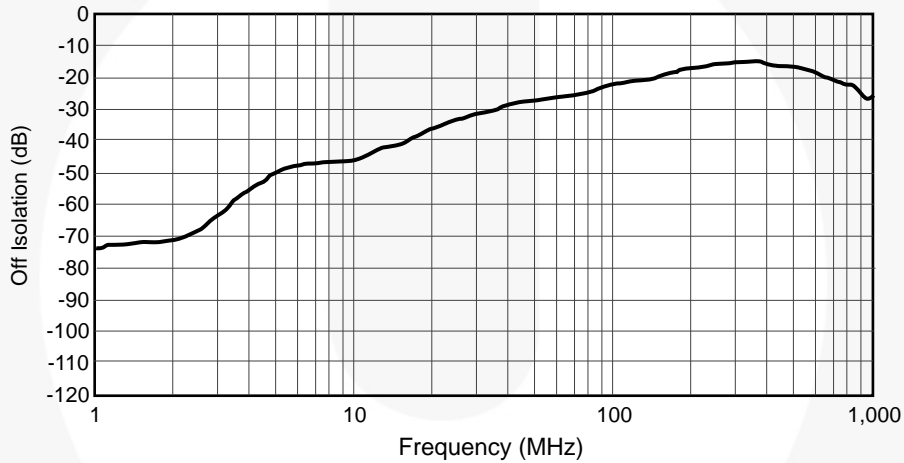


Figure 4. Crosstalk, $V_{CC} = 2.7\text{ V to }5.5\text{ V}$

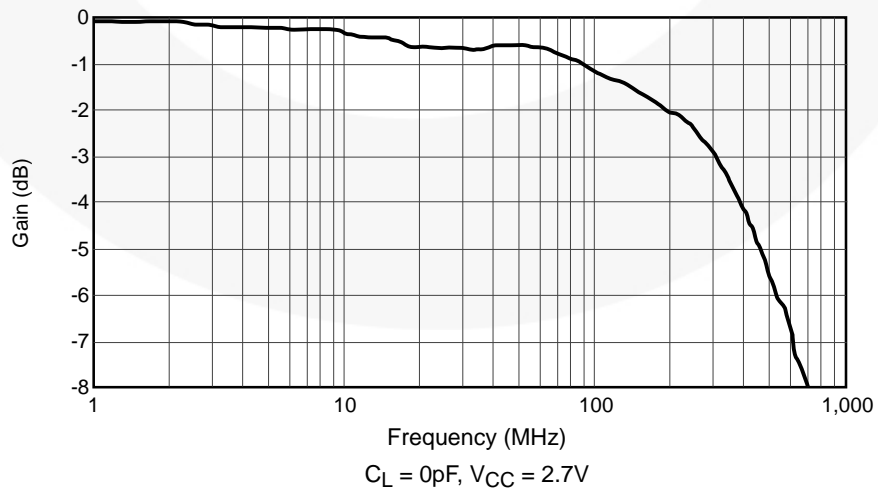


Figure 5. Bandwidth, $V_{CC} = 2.7\text{ V to }5.5\text{ V}$

Typical Performance Characteristics (Continued)

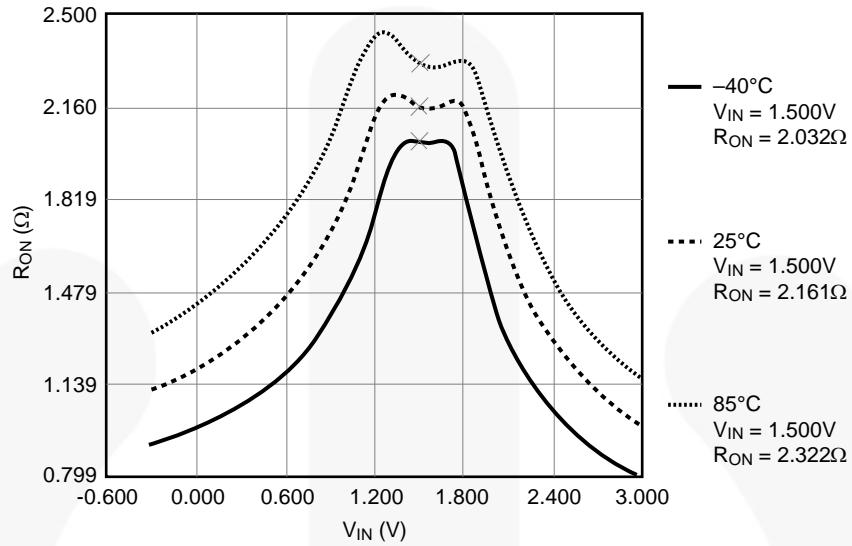


Figure 6. R_{ON} Switch On Resistance, I_{ON} = 100 mA, V_{CC} = 2.7

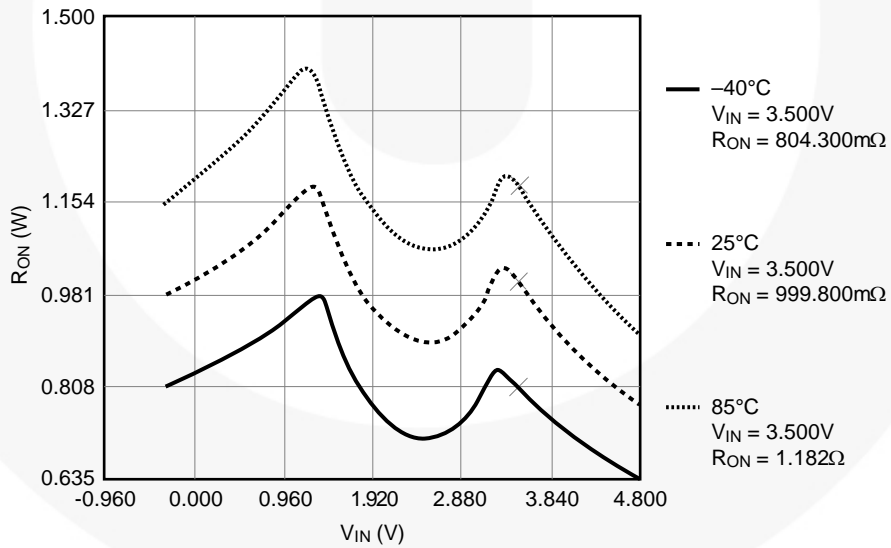


Figure 7. R_{ON} Switch On Resistance, I_{ON} = 100 mA, V_{CC} = 4.5 V

AC Loadings and Waveforms

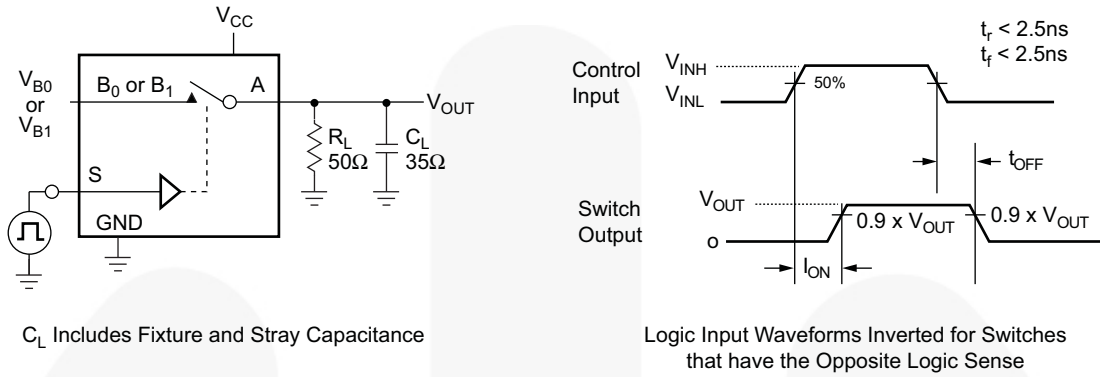


Figure 8. Turn On / Off Timing

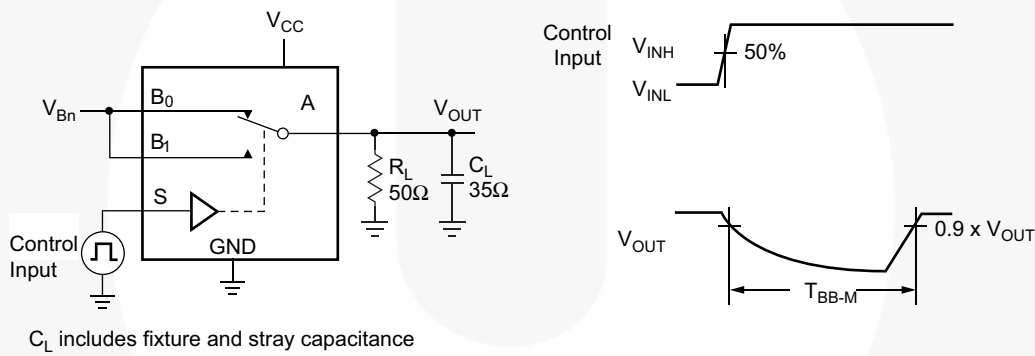


Figure 9. Break Before Make Timing

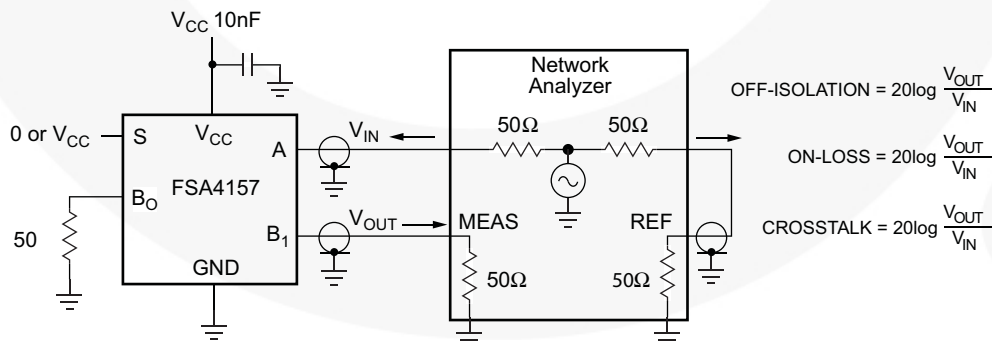


Figure 10. Off Isolation and Crosstalk

AC Loadings and Waveforms (Continued)

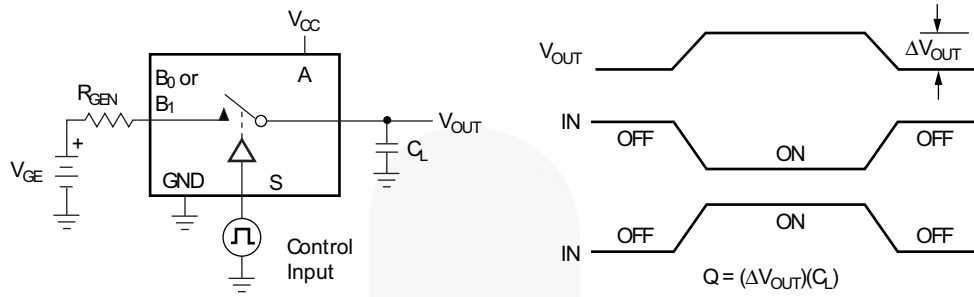


Figure 11. Charge Injection

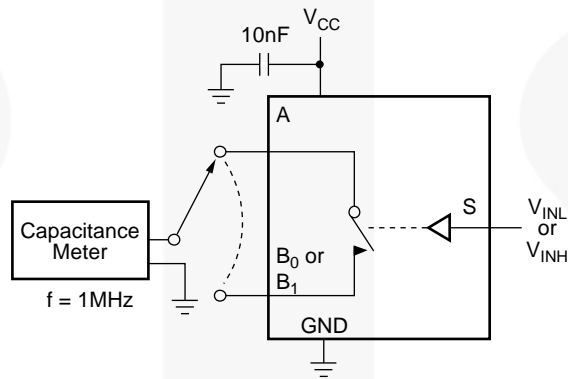


Figure 12. On / Off Capacitance Measurement Setup

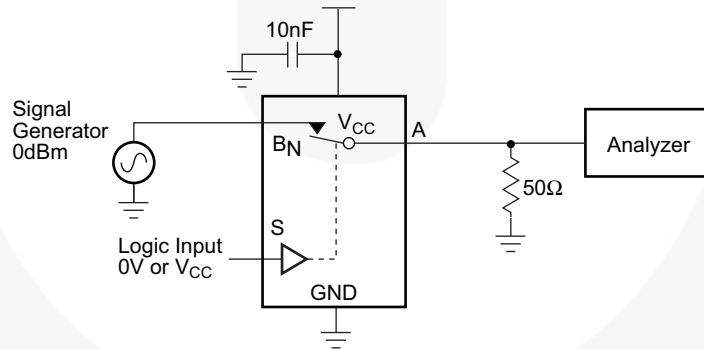


Figure 13. Bandwidth

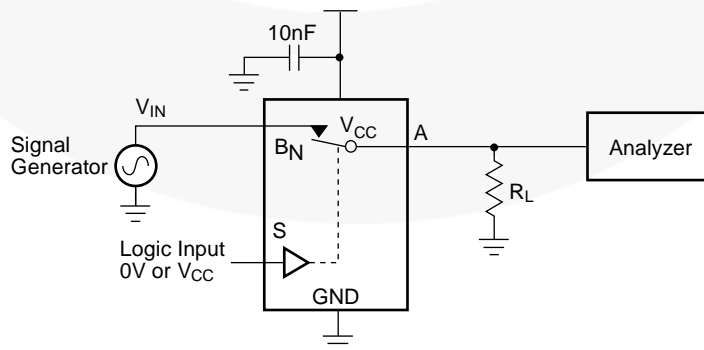
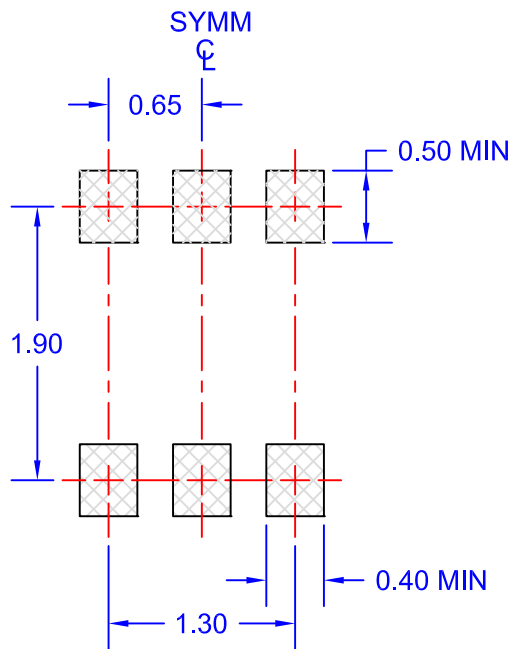
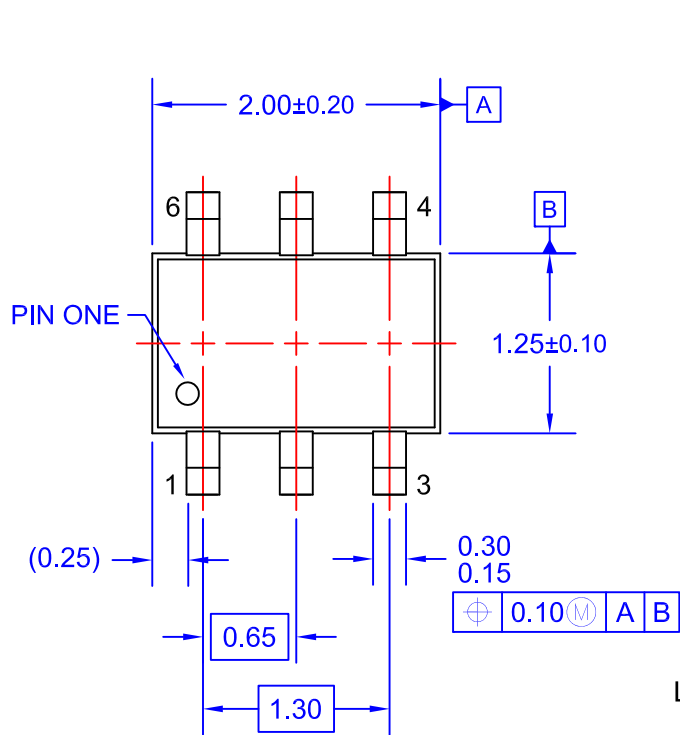
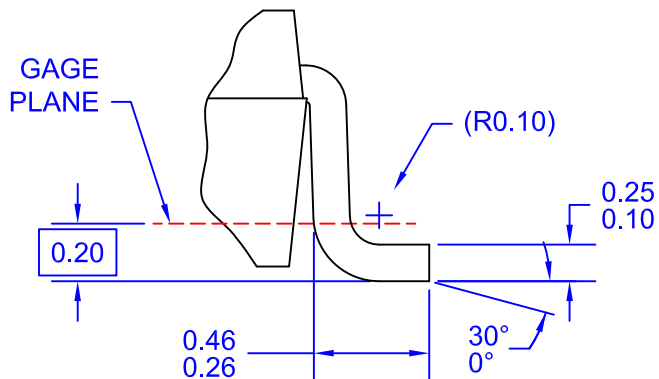
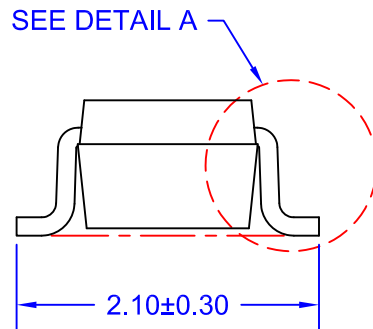
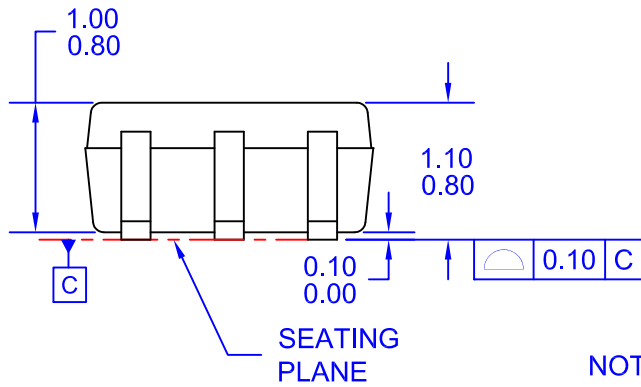


Figure 14. Harmonic Distortion



LAND PATTERN RECOMMENDATION



DETAIL A
SCALE: 60X

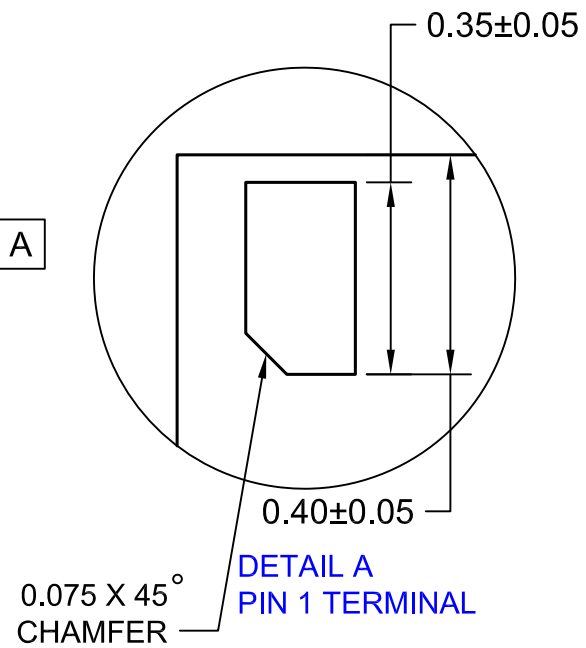
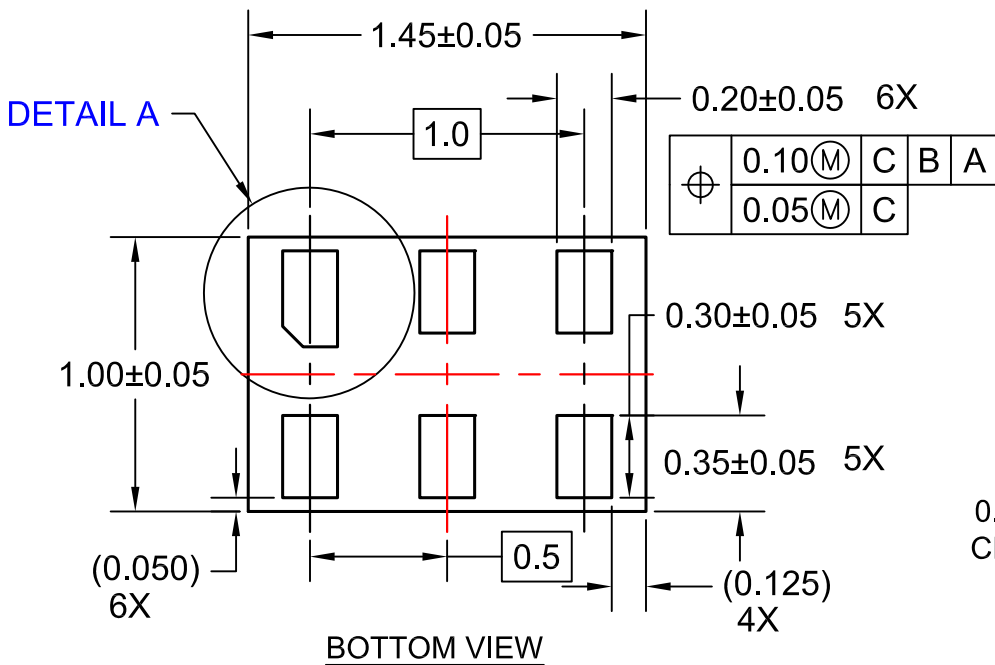
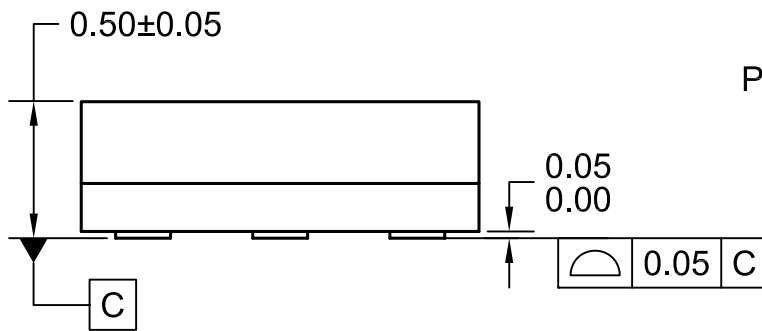
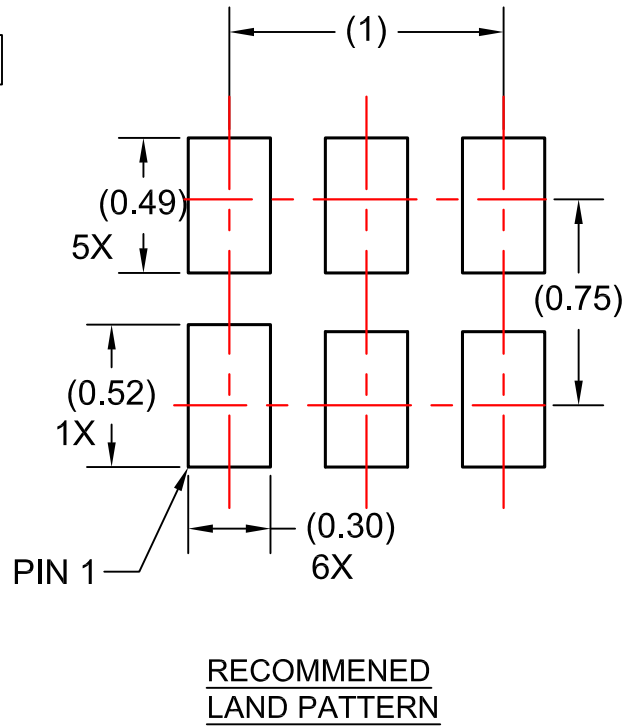
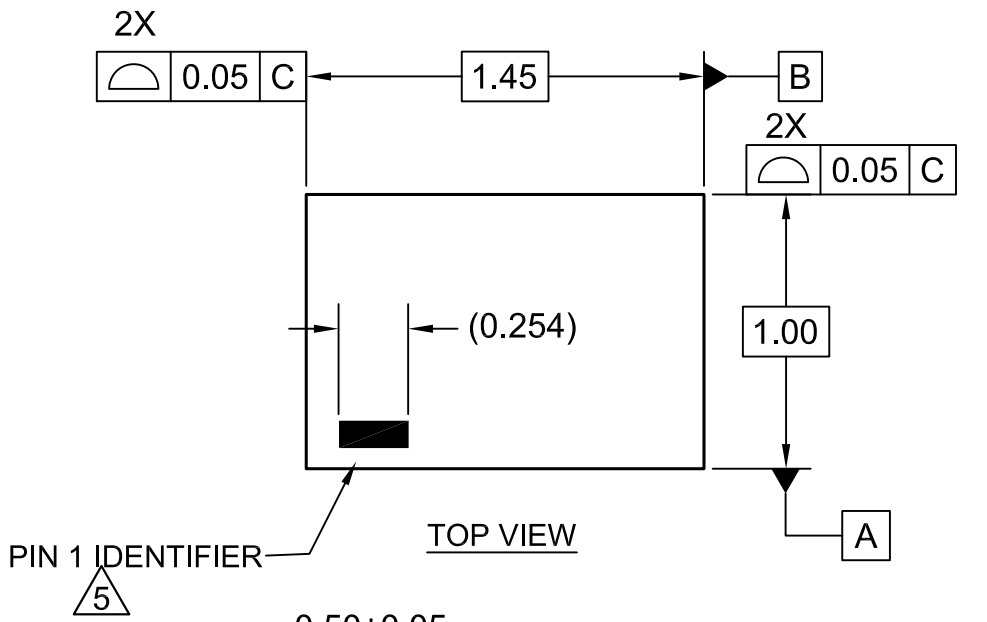
NOTES: UNLESS OTHERWISE SPECIFIED
A) THIS PACKAGE CONFORMS TO EIAJ SC-88, 1996.

B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH.

D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009

E) DRAWING FILENAME: MKT-MAA06AREV7





NOTES:

1. CONFORMS TO JEDEC STANDARD MO-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-2009
4. LANDPATTERN RECOMMENDATION PER FSC
5. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY OTHER LINE IN THE MARK CODE LAYOUT.
6. FILENAME AND REVISION: MAC06AREV6



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