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# FSA2257

## Low R<sub>ON</sub>, Low-Voltage Dual SPDT Bi-Directional Analog Switch

### Features

- Maximum 1.15 Ω On Resistance (R<sub>ON</sub>) at 4.5 V V<sub>CC</sub>
- 0.3 Ω Maximum R<sub>ON</sub> Flatness at +5 V V<sub>CC</sub>
- Space-Saving MicroPak™
- Broad V<sub>CC</sub> Operating Range: 1.65 V to 5.50 V
- Fast Turn-On and Turn-Off Time
- Break-Before-Make Enable Circuitry
- Over-Voltage Tolerant TTL-Compatible Control Input

### Description

The FSA2257 is a high-performance bi-directional dual Single-Pole/Double-Throw (SPDT) analog switch. This switch can be configured as either a multiplexer or a de-multiplexer by select pins. The device features ultra-low R<sub>ON</sub> of 1.3 Ω maximum at 4.5 V V<sub>CC</sub> and operates over the wide V<sub>CC</sub> range of 1.65 V to 5.50 V. The device is fabricated with submicron CMOS technology to achieve fast switching speeds and is designed for break-before-make operation. The select input is TTL-level compatible.

### Applications

- Cell Phone
- PDA
- Mobile Devices

### Ordering Information

| Part Number | Package Number | Top Mark | Package Description  | Packing Method           |
|-------------|----------------|----------|--|--------------------------|
| FSA2257L10X | MAC10A         | EP       | 10-Lead MicroPak™, 1.6 x 2.1 mm  | 5000 Units Tape and Reel |
| FSA2257MTCX | MCT14          | FSA2257  | 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4 mm Wide | 2500 Units Tape and Reel |
| FSA2257MUX  | MUA10A         | FSA 2257 | 10-Lead Molded Small Outline Package (MSOP), JEDEC MO-187, 3.0 mm            | 4000 Units Tape and Reel |

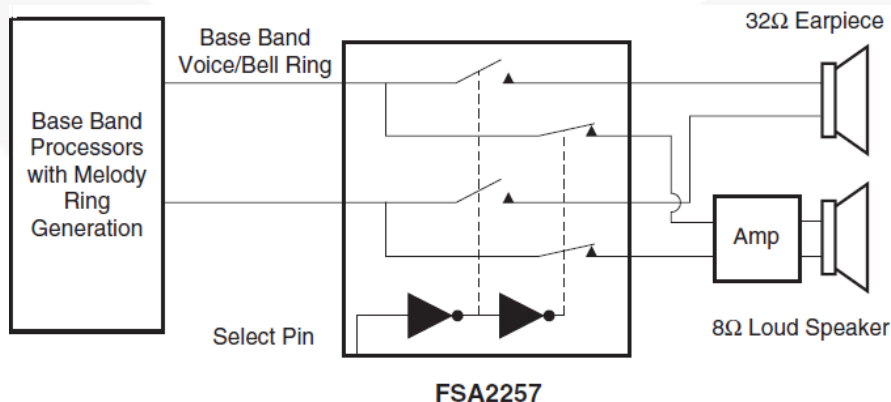


Figure 1. Block Diagram

## Pin Configurations

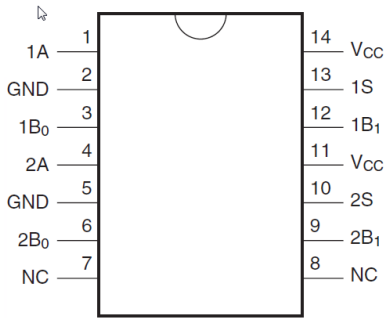


Figure 2. Pin Assignments for TSSOP (Top View)

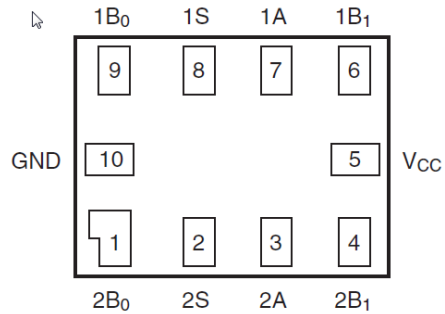


Figure 3. MicroPak™ Pad Assignments (Top View)

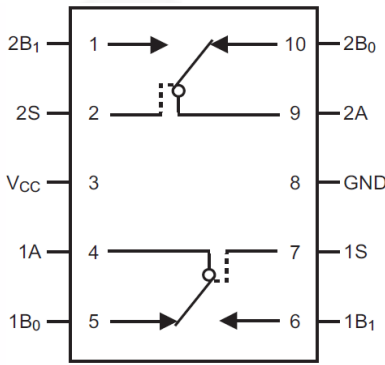


Figure 4. Pin Assignments for MSOP (Top View)

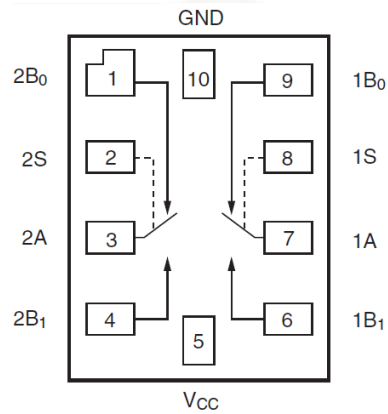


Figure 5. Analog Symbols (Top Through View)

## Pin Definitions

| Pin#<br>TSSOP | Pin#<br>MicroPak™ | Pin #<br>MSOP | Name            | Description    |
|---------------|-------------------|---------------|-----------------|----------------|
| 1             | 7                 | 4             | 1A              | Data Ports     |
| 2,5           | 10                | 8             | GND             | Ground         |
| 3             | 9                 | 5             | 1B <sub>0</sub> | Data Ports     |
| 4             | 3                 | 9             | 2A              | Data Ports     |
| 6             | 1                 | 10            | 2B <sub>0</sub> | Data Ports     |
| 7,8           |                   |               | NC              | No Connect     |
| 9             | 4                 | 1             | 2B <sub>1</sub> | Data Ports     |
| 10            | 2                 | 2             | 2S              | Control Inputs |
| 11,14         | 5                 | 3             | V <sub>CC</sub> | Power Supply   |
| 12            | 6                 | 6             | 1B <sub>1</sub> | Data Ports     |
| 13            | 8                 | 7             | 1S              | Control Inputs |

## Truth Table

| Control Input (S) | Function                      |
|-------------------|-------------------------------|
| Low Logic Level   | B <sub>0</sub> connected to A |
| High Logic Level  | B <sub>1</sub> 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 <sub>CC</sub>  | Supply Voltage   | -0.5                              | 6.0                   | V    |
| V <sub>SW</sub>  | DC Switch Voltage <sup>(1)</sup>                               | -0.5                              | V <sub>CC</sub> + 0.5 | V    |
| V <sub>IN</sub>  | DC Input Voltage <sup>(1)</sup>                                | -0.5                              | 6.0                   | V    |
| I <sub>IK</sub>  | Input Diode Current  | -50                               |                       | mA   |
|                  | Switch Current   |                                   | 200                   |      |
|                  | Peak Switch Current (Pulsed at 1 ms duration, <10% duty cycle) |                                   | 400                   |      |
| T <sub>STG</sub> | Storage Temperature Range                                      | -65                               | +150                  | °C   |
| T <sub>J</sub>   | Maximum Junction Temperature                                   |                                   | +150                  | °C   |
| T <sub>L</sub>   | Lead Temperature (Soldering, 10 seconds)                       |                                   | +260                  | °C   |
| ESD              | Electrostatic Discharge Capability                             | Human Body Model, JESD22-A114     | 8000                  | V    |
|                  |  | Charged Device Model, JESD22-C101 | 2000                  |      |

**Note:**

1. 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 <sub>CC</sub>    | Supply Voltage                       | 1.65 | 5.50            | V    |
| V <sub>CNTRL</sub> | Control Input Voltage <sup>(2)</sup> | 0    | V <sub>CC</sub> | V    |
| V <sub>SW</sub>    | Switch Input Voltage                 | 0    | V <sub>CC</sub> | V    |
| T <sub>A</sub>     | Operating Temperature                | -40  | +85             | °C   |

**Note:**

2. Unused 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 <sub>CC</sub> (V) | T <sub>A</sub> =+25°C |      |      | T <sub>A</sub> =-40°C to +85°C |      | Unit |
|--|---|--|---------------------|-----------------------|------|------|--------------------------------|------|------|
|  |   |  |                     | Min.                  | Typ. | Max. | Min.                           | Max. |      |
| V <sub>IH</sub>                                | Input Voltage High  |  | 1.8 to 2.7          |                       |      |      | 1.0                            |      | V    |
|  |   |  | 2.7 to 3.6          |                       |      |      | 2.0                            |      |      |
|  |   |  | 4.5 to 5.5          |                       |      |      | 2.4                            |      |      |
| V <sub>IL</sub>                                | Input Voltage Low   |  | 1.8 to 2.7          |                       |      |      |                                | 0.4  | V    |
|  |   |  | 2.7 to 3.6          |                       |      |      |                                | 0.6  |      |
|  |   |  | 4.5 to 5.5          |                       |      |      |                                | 0.8  |      |
| I <sub>IN</sub>                                | Control Input Leakage   | V <sub>IN</sub> =0 V to V <sub>CC</sub>  | 2.7 to 3.6          |                       |      |      | -1.0                           | 1.0  | μA   |
|  |   |  | 4.5 to 5.5          |                       |      |      | -1.0                           | 1.0  |      |
| I <sub>NO(OFF)</sub> ,<br>I <sub>NC(OFF)</sub> | Off Leakage Current of Port B <sub>0</sub> and B <sub>1</sub>   | A=1 V, 4.5 V, B <sub>0</sub> or B <sub>1</sub> =1 V, 4.5 V                     | 5.5                 | -2                    |      | 2    | -20                            | 20   | nA   |
| I <sub>A(ON)</sub>                             | On Leakage Current of Port A                                    | A=1 V, 4.5V, B <sub>0</sub> or B <sub>1</sub> =1 V, 4.5 V or Floating          | 5.5                 | -4                    |      | 2    | -40                            | 40   | nA   |
| R <sub>ON</sub>                                | Switch On Resistance MicroPak <sup>(3)</sup>                    | I <sub>OUT</sub> =100 mA, B <sub>0</sub> or B <sub>1</sub> =1.5 V              | 1.8                 |                       | 4.6  |      |                                |      | Ω    |
|  |   |  | 2.7                 |                       | 2.6  | 4.0  |                                | 4.3  |      |
|  | Switch On Resistance MSOP/TSSOP <sup>(3)</sup>                  | I <sub>OUT</sub> =100 mA, B <sub>0</sub> or B <sub>1</sub> =3.5 V              | 4.5                 |                       | 0.95 | 1.15 |                                | 1.30 |      |
|  |   |  | 2.7                 |                       | 2.8  |      |                                | 4.5  |      |
| ΔR <sub>ON</sub>                               | On Resistance Matching Between Channels MicroPak <sup>(4)</sup> | I <sub>OUT</sub> =100 mA, B <sub>0</sub> or B <sub>1</sub> =3.5 V              | 4.5                 |                       | 0.06 | 0.12 |                                | 0.15 | Ω    |
|  |   |  | 4.5                 |                       | 0.7  |      |                                | 0.3  |      |
| R <sub>FLAT(ON)</sub>                          | On Resistance Flatness <sup>(5)</sup>                           | I <sub>OUT</sub> =100 mA, B <sub>0</sub> or B <sub>1</sub> =0 V, 0.75 V, 1.5 V | 1.8                 |                       | 3.0  |      |                                |      | Ω    |
|  |   |  | 2.7                 |                       | 1.4  |      |                                |      |      |
|  |   | I <sub>OUT</sub> =100 mA, B <sub>0</sub> or B <sub>1</sub> =0 V, 1 V, 2 V      | 4.5                 |                       | 0.2  | 0.3  |                                | 0.4  |      |
| I <sub>CC</sub>                                | Quiescent Supply Current  | V <sub>IN</sub> =0 V or V <sub>CC</sub> , I <sub>OUT</sub> =0 V                | 3.6                 |                       | 0.1  | 0.5  |                                | 1.0  | μA   |
|  |   |  | 5.5                 |                       | 0.1  | 0.5  |                                | 1.0  |      |

### Notes:

- On resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.
- ΔR<sub>ON</sub> = R<sub>ONmax</sub> – R<sub>ONmin</sub> measured at identical V<sub>CC</sub>, 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

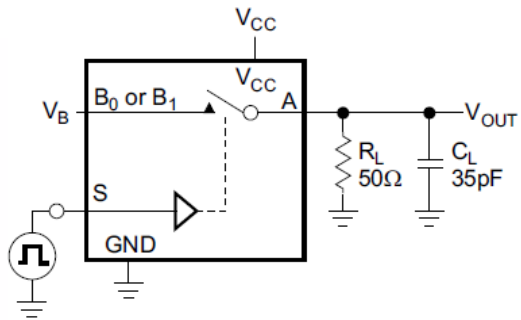
Typical values are at 25°C unless otherwise specified.

| Symbol           | Parameter                 | Conditions  | V <sub>CC</sub> (V) | T <sub>A</sub> =+25°C |       |      | T <sub>A</sub> =-40°C to +85°C |      | Unit      | Figure   |
|------------------|---------------------------|---|---------------------|-----------------------|-------|------|--------------------------------|------|-----------|----------|
|                  |                           |   |                     | Min.                  | Typ.  | Max. | Min.                           | Max. |           |          |
| t <sub>ON</sub>  | Turn-On Time              | B <sub>0</sub> or B <sub>1</sub> =1.5 V,<br>R <sub>L</sub> =50 Ω, C <sub>L</sub> =35 pF | 1.8 to 2.7          |                       | 75    |      |                                |      | ns        | Figure 6 |
|                  |                           |   | 2.7 to 3.6          |                       |       | 50   |                                | 60   |           |          |
|                  |                           | B <sub>0</sub> or B <sub>1</sub> =3.0 V,<br>R <sub>L</sub> =50 Ω, C <sub>L</sub> =35 pF | 4.5 to 5.5          |                       |       | 35   |                                | 40   |           |          |
| t <sub>OFF</sub> | Turn-Off Time             | B <sub>0</sub> or B <sub>1</sub> =1.5 V,<br>R <sub>L</sub> =50 Ω, C <sub>L</sub> =35 pF | 1.8 to 2.7          |                       | 20    |      |                                | ns   | Figure 6  |          |
|                  |                           |   | 2.7 to 3.6          |                       |       | 20   |                                |      |           | 30       |
|                  |                           | B <sub>0</sub> or B <sub>1</sub> =3.0 V,<br>R <sub>L</sub> =50 Ω, C <sub>L</sub> =35 pF | 4.5 to 5.5          |                       |       | 15   |                                |      |           | 20       |
| t <sub>BBM</sub> | Break-Before-Make Time    | B <sub>0</sub> or B <sub>1</sub> =1.5 V,<br>R <sub>L</sub> =50 Ω, C <sub>L</sub> =35 pF | 2.7 to 3.6          |                       |       |      | 1                              | ns   | Figure 7  |          |
|                  |                           |   | 4.5 to 5.5          |                       | 20    |      | 1                              |      |           |          |
| Q                | Charge Injection          | C <sub>L</sub> =1.0 nF, V <sub>GEN</sub> =0 V,<br>R <sub>GEN</sub> =0 Ω                 | 2.7 to 3.6          |                       | 20    |      |                                | pC   | Figure 9  |          |
|                  |                           |   | 4.5 to 5.5          |                       | 10    |      |                                |      |           |          |
| OIRR             | Off Isolation             | f=1 MHz, R <sub>L</sub> =50 Ω   | 2.7 to 3.6          |                       | -70   |      |                                | dB   | Figure 8  |          |
|                  |                           |   | 4.5 to 5.5          |                       | -70   |      |                                |      |           |          |
| Xtalk            | Crosstalk                 | f=1 MHz, R <sub>L</sub> =50 Ω   | 2.7 to 3.6          |                       | -75   |      |                                | dB   | Figure 8  |          |
|                  |                           |   | 4.5 to 5.5          |                       | -75   |      |                                |      |           |          |
| BW               | -3 db Bandwidth           | R <sub>L</sub> =50 Ω  | 2.7 to 3.6          |                       | 200   |      |                                | MHz  | Figure 11 |          |
|                  |                           |   | 4.5 to 5.5          |                       | 200   |      |                                |      |           |          |
| THD              | Total Harmonic Distortion | R <sub>L</sub> =600 Ω, V <sub>IN</sub> =0.5 V <sub>PP</sub><br>f=20 Hz to 20 kHz        | 2.7 to 3.6          |                       | 0.002 |      |                                | %    | Figure 12 |          |
|                  |                           |   | 4.5 to 5.5          |                       | 0.002 |      |                                |      |           |          |

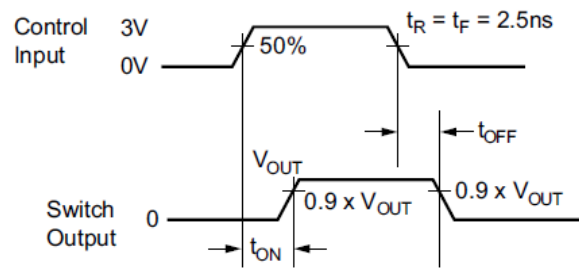
## Capacitance

| Symbol           | Parameter                     | Conditions | V <sub>CC</sub> (V) | T <sub>A</sub> =+25°C |      |      | Unit | Figure    |
|------------------|-------------------------------|------------|---------------------|-----------------------|------|------|------|-----------|
|                  |                               |            |                     | Min.                  | Typ. | Max. |      |           |
| C <sub>IN</sub>  | Control Pin Input Capacitance | f=1 MHz    | 0                   |                       | 3.5  |      | pF   | Figure 10 |
| C <sub>OFF</sub> | B Port Off Capacitance        | f=1 MHz    | 4.5                 |                       | 12.0 |      | pF   | Figure 10 |
| C <sub>ON</sub>  | A Port On Capacitance         | f=1 MHz    | 4.5                 |                       | 40.0 |      | pF   | Figure 10 |

## AC Loadings and Waveforms

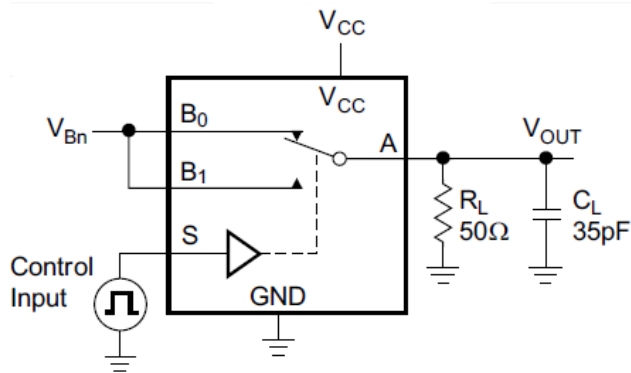


$C_L$  Includes Fixture and Stray Capacitance



Logic Input Waveforms Inverted for Switches that have the Opposite Logic Sense

Figure 6. Turn On / Off Timing



$C_L$  Includes Fixture and Stray Capacitance

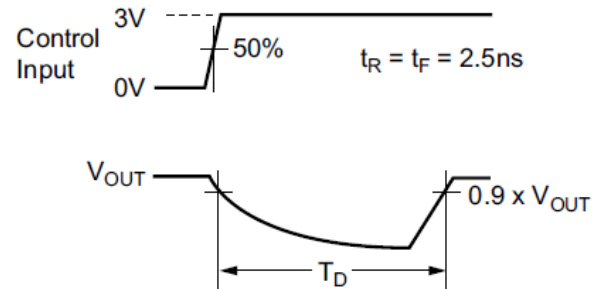


Figure 7. Break Before Make Timing

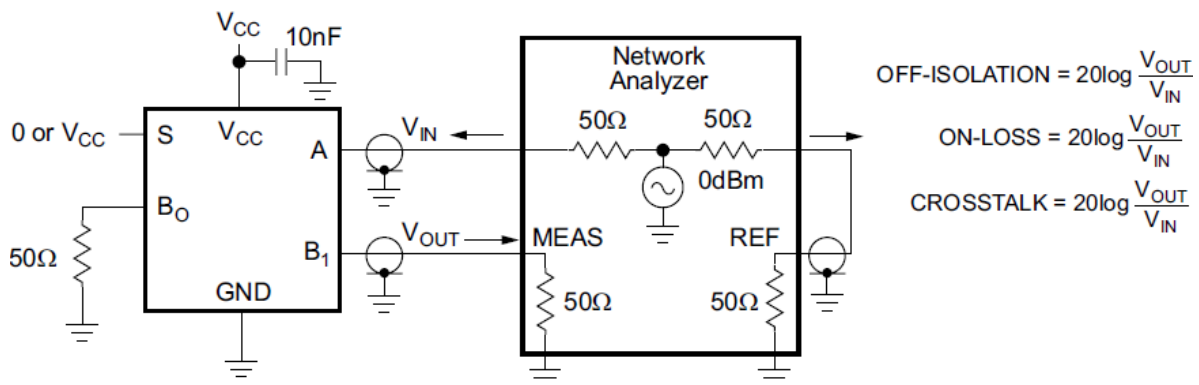


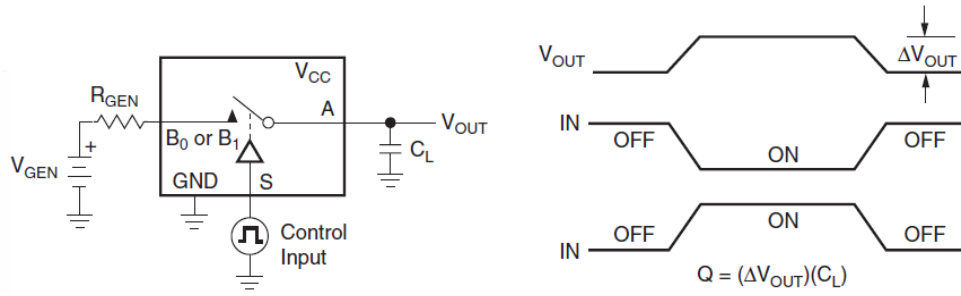
Figure 8. Off Isolation and Crosstalk

$$\text{OFF-ISOLATION} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

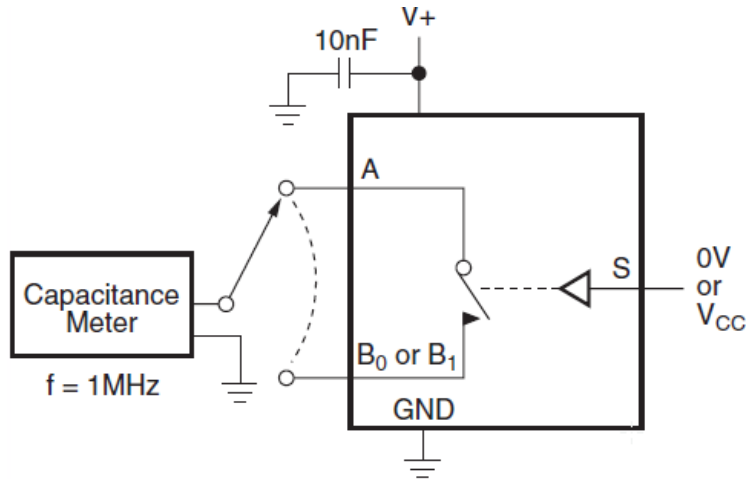
$$\text{ON-LOSS} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

$$\text{CROSSTALK} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

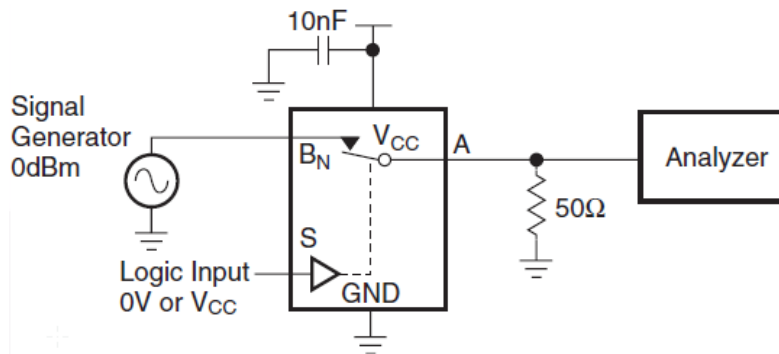
**AC Loadings and Waveforms (Continued)**



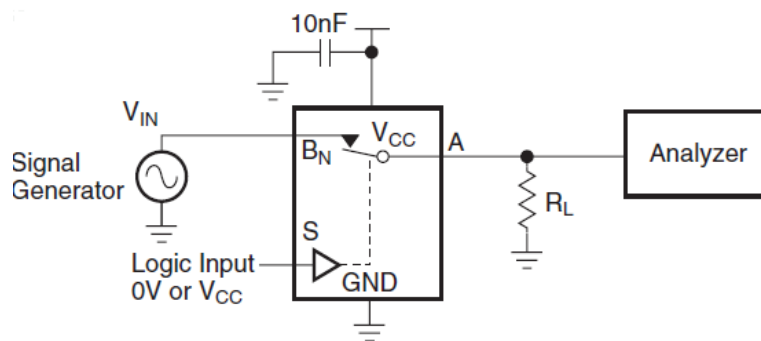
**Figure 9. Charge Injection**



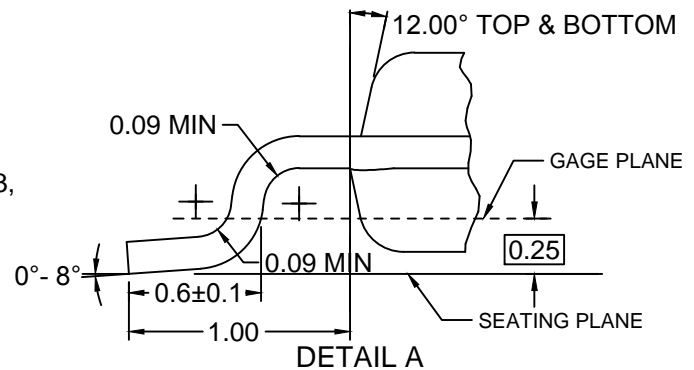
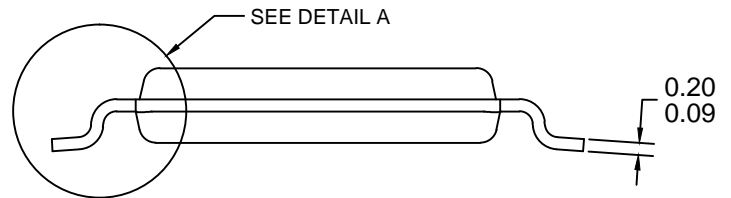
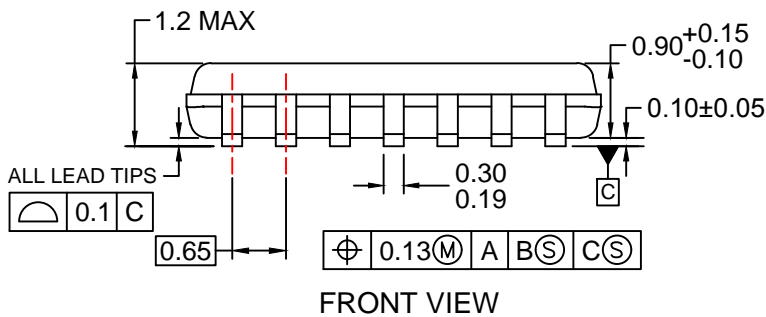
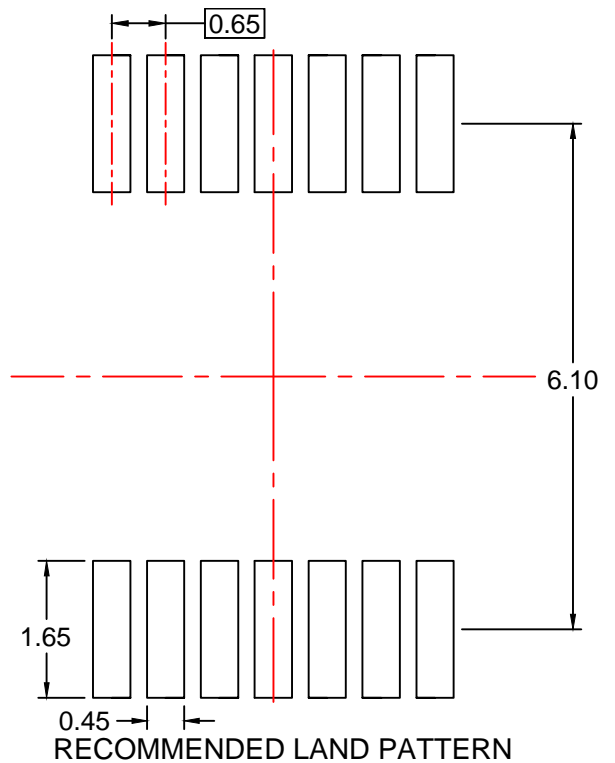
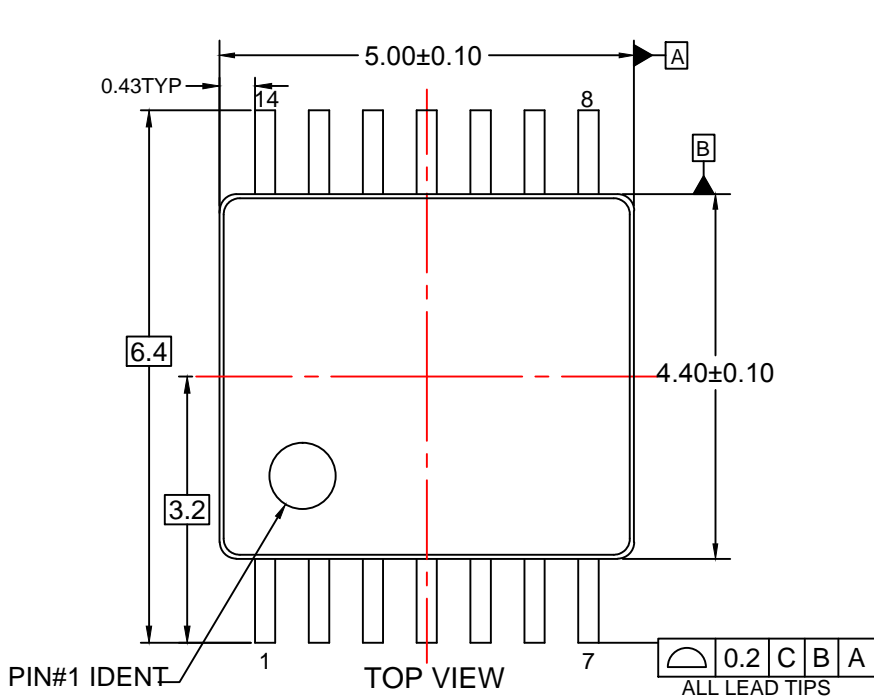
**Figure 10. On / Off Capacitance Measurement Setup**



**Figure 11. Bandwidth**



**Figure 12. Harmonic Distortion**



**NOTES:**

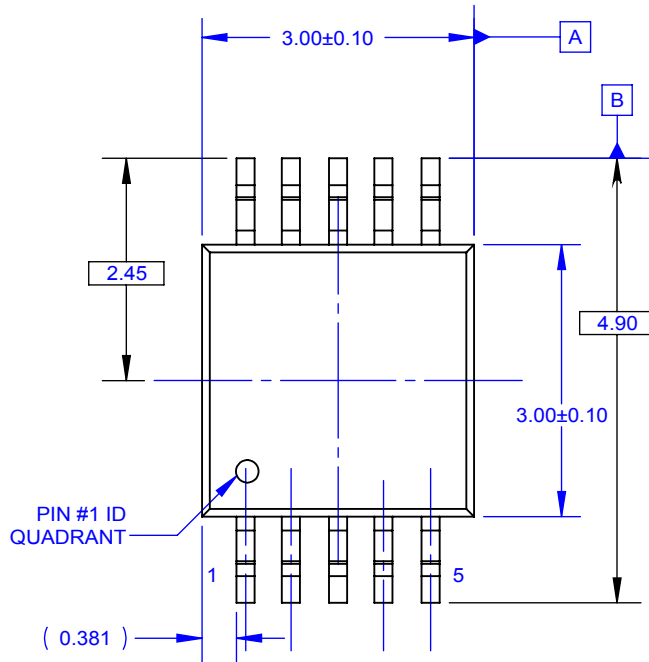
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- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
- D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 2009.
- E. LANDPATTERN STANDARD: SOP65P640X110-14M.
- F. DRAWING FILE NAME: MKT-MTC14rev7.



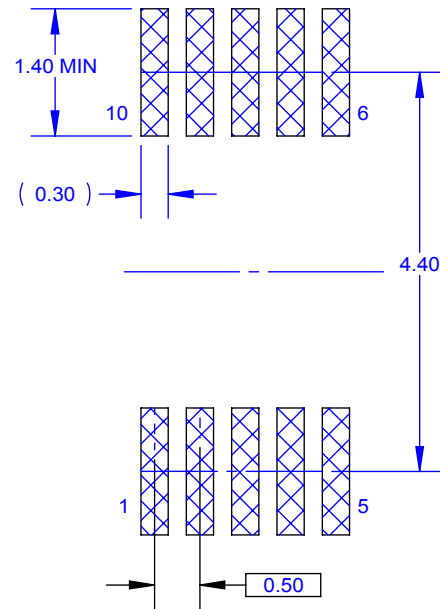
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### REVISIONS

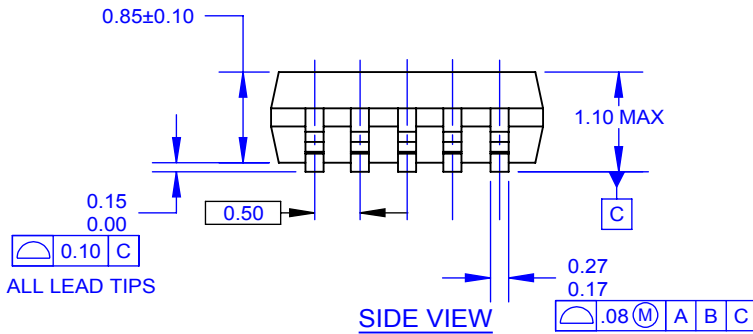
| NBR | DESCRIPTION  | DATE      | BY/APP'D   |
|-----|--|-----------|------------|
| B   | REDREW FORMER NSC DWG  | 07JUN2006 | H.ALLEN    |
| 2   | * REMOVE SITE ADDRESS AND CHANGE REVISION TO NUMERICAL & CHANGED LAND PATTERN TO IPC.<br>* CHANGE LEAD WIDTH FROM 0.27MM MAX TO 0.33MM MAX.<br>* REMOVE DATE OF JEDEC REVISION | 20AUG2009 | KHLEE/FSSZ |
| 3   | * REVERT LEAD WIDTH TO 0.27MM MAX.   | 24SEP2009 | KHLEE/FSSZ |



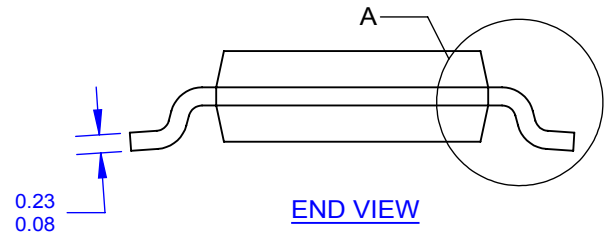
TOP VIEW



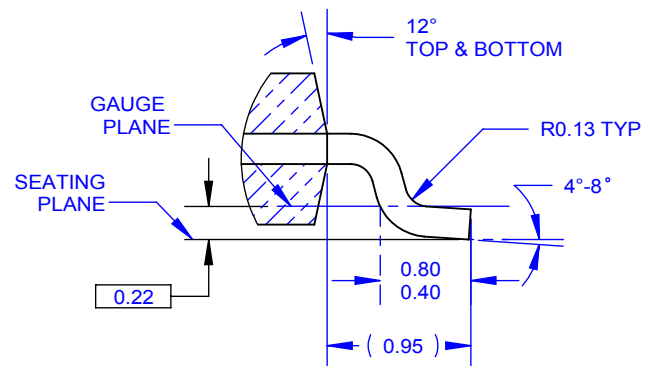
LAND PATTERN RECOMMENDATION



SIDE VIEW



END VIEW



DETAIL A  
SCALE 20 : 1

NOTES: UNLESS OTHERWISE SPECIFIED

- A. THIS PACKAGE CONFORMS TO JEDEC MO-187 VARIATION BA.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
- D. DIMENSIONS AND TOLERANCES AS PER ASME Y14.5-1994.
- E. LAND PATTERN AS PER IPC7351#SOP50P490X110-10AN
- F. FILE NAME: MKT-MUA10AREV3

| APPROVALS              |  | DATE    | <br>10LD, MSOP, JEDEC MO-187, 3.0MM WIDE |          |                           |       |
|------------------------|--|---------|--|----------|---------------------------|-------|
| DRAWN: BOBOY MALDO     |  | 24SEP09 |  |          |                           |       |
| CHECKED: KH LEE        |  |         |  |          |                           |       |
| APPROVED: BY HUANG     |  |         |  |          |                           |       |
| APPROVED: HOWARD ALLEN |  |         | SCALE 1:1                                | SIZE N/A | DRAWING NUMBER MKT-MUA10A | REV 3 |
| PROJECTION             |  |         | FORMERLY: N/A                            |          | SHEET: 1 OF 1             |       |



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