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ON Semiconductor®

# FSA2268 / FSA2268T Low-Voltage Dual-SPDT (0.4Ω) Analog Switch with 16kV ESD

## Features

- 0.4Ω Typical On Resistance ( $R_{ON}$ ) for +3.0V Supply
- 0.25Ω Maximum  $R_{ON}$  Flatness for +3.0V Supply
- -3db Bandwidth: > 50MHz
- Low  $I_{CCT}$  Current Over an Expanded Control Input Range
- Packaged in Pb-free 10-Lead  $\mu$ MLP (1.4 x 1.8mm)
- Power-Off Protection on Common Ports
- Broad  $V_{CC}$  Operating Range: 1.65 to 4.3V
- HBM JEDEC: JESD22-A114
  - I/O to GND: 13.5kV
  - Power to GND: 16.0kV
- Noise Immunity Termination Resistors in FSA2268T

## Applications

- Cell Phone, PDA, Digital Camera, and Notebook
- LCD Monitor, TV, and Set-Top Box

## Description

The FSA2268 is a high-performance, dual Single Pole Double Throw (SPDT) analog switch that features ultra-low  $R_{ON}$  of 0.4Ω (typical) at 3.0V  $V_{CC}$ . The FSA2268 operates over a wide  $V_{CC}$  range of 1.65V to 4.3V and is designed for break-before-make operation. The select input is TTL-level compatible.

The FSA2268 features very low quiescent current even when the control voltage is lower than the  $V_{CC}$  supply. This feature suits mobile handset applications by allowing direct interface with baseband processor general-purpose I/Os with minimal battery consumption.

The FSA2268T includes termination resistors that improve noise immunity during overshoot excursions, off-isolation coupling, or “pop-minimization.”

## Ordering Information

| Part Number | Top Mark | Package Description  |
|-------------|----------|--|
| FSA2268UMX  | GF       | 10-Lead, Quad Ultrathin Molded Leadless Package (UMLP), 1.4 x 1.8mm, 0.4mm Pitch |
| FSA2268TUMX | GH       | 10-Lead, Quad Ultrathin Molded Leadless Package (UMLP), 1.4 x 1.8mm, 0.4mm Pitch |
| FSA2268L10X | GH       | 10-Lead, MicroPak™, 1.6mm Wide   |

## Analog Symbols

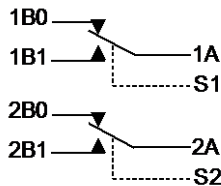


Figure 1. FSA2268

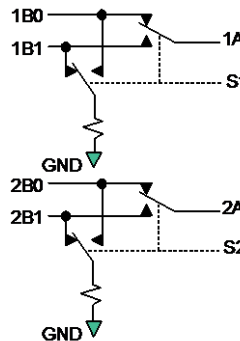


Figure 2. FSA2268T (with Noise Termination Resistors)

## Pin Configuration

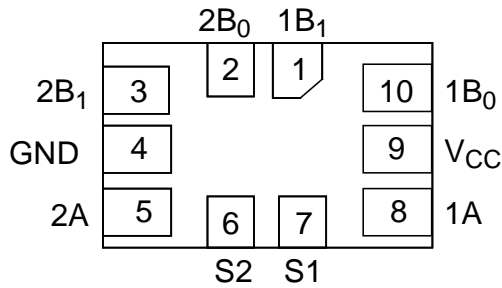


Figure 3. Pin Assignment 10-Pin UMLP (Top-Through View)

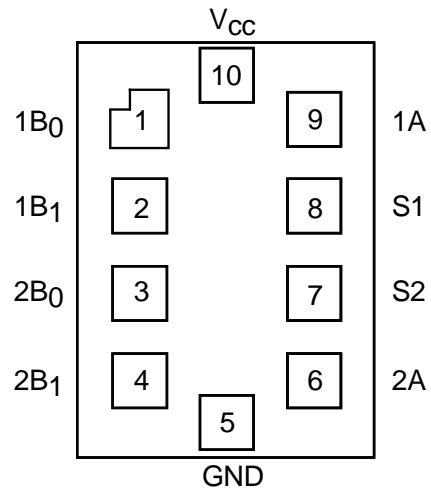


Figure 4. 10-Lead MicroPak™

## Pin Descriptions

| Pin # UMLP | Pin # MicroPak™ | Name            | Description        |
|------------|-----------------|-----------------|--------------------|
| 1          | 2               | 1B <sub>1</sub> | Data Ports         |
| 2          | 3               | 2B <sub>0</sub> | Data Ports         |
| 3          | 4               | 2B <sub>1</sub> | Data Ports         |
| 4          | 5               | GND             | Ground             |
| 5          | 6               | 2A              | Data Ports         |
| 6          | 7               | S2              | Switch Select Pins |
| 7          | 8               | S1              | Switch Select Pins |
| 8          | 9               | 1A              | Data Ports         |
| 9          | 10              | V <sub>CC</sub> | Supply Voltage     |
| 10         | 1               | 1B <sub>0</sub> | Data Ports         |

## Truth Table

| Control Input, S <sub>n</sub> | Function   |
|-------------------------------|--|
| LOW Logic Level               | nB <sub>0</sub> connected to nA (FSA2268/2268T); nB <sub>1</sub> terminated to GND (FSA2268T only) |
| HIGH Logic Level              | nB <sub>1</sub> connected to nA (FSA2268/2268T); nB <sub>0</sub> terminated to GND (FSA2268T only) |

## 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              |    |
| $V_{SW}$     | Switch I/O Voltage <sup>(1)</sup>                             | 1B0, 1B1, 2B0, 2B1, 1A, 2A Pins | -0.5 | $V_{CC} + 0.3$ | V  |
|              |   | T Version nBn Pin Off           | 0    | 1.4            |    |
| $V_{IN}$     | Control Input Voltage <sup>(1)</sup>                          | -0.5                            | 5.5  | V              |    |
| $I_{IK}$     | Input Clamp Diode Current                                     |                                 | -50  | mA             |    |
| $I_{SW}$     | Switch I/O Current (Continuous)                               |                                 | 350  | mA             |    |
| $I_{SWPEAK}$ | Peak Switch Current (Pulsed at 1ms Duration, <10% Duty Cycle) |                                 | 500  | mA             |    |
| $T_{STG}$    | Storage Temperature Range                                     | -65                             | +150 | °C             |    |
| $T_J$        | Maximum Junction Temperature                                  |                                 | +150 | °C             |    |
| $T_L$        | Lead Temperature (Soldering, 10 seconds)                      |                                 | +260 | °C             |    |
| MSL          | Moisture Sensitivity Level (JEDEC J-STD-020A)                 |                                 | 1    | Level          |    |
| ESD          | Human Body Model, JEDEC: JESD22-A114                          | I/O to GND                      |      | 13.5           | kV |
|              |   | Power to GND                    |      | 16.0           |    |
|              |   | All Other Pins                  |      | 9.0            |    |
|              | Charged Device Model, JEDEC: JESD22-C101                      |                                 |      | 2.0            | kV |

**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. ON Semiconductor does not recommend exceeding them or designing to Absolute Maximum Ratings.

| Symbol   | Parameter             | Min. | Max.     | Units |
|----------|-----------------------|------|----------|-------|
| $V_{CC}$ | Supply Voltage        | 1.65 | 4.30     | V     |
| $V_{IN}$ | Control Input Voltage | 0    | $V_{CC}$ | V     |
| $V_{SW}$ | Switch I/O Voltage    | 0    | $V_{CC}$ | V     |
| $T_A$    | Operating Temperature | -40  | +85      | °C    |

## DC Electrical Characteristics

All 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 to +85°C |      | Unit |
|---|--|---|---------------------|-----------------------|------|------|------------------------------|------|------|
|   |  |   |                     | Min.                  | Typ. | Max. | Min.                         | Max. |      |
| V <sub>IH</sub>   | Input Voltage High   |   | 3.6 to 4.3          |                       |      |      | 1.7                          |      | V    |
|   |  |   | 2.7 to 3.6          |                       |      |      | 1.5                          |      |      |
|   |  |   | 2.3 to 2.7          |                       |      |      | 1.4                          |      |      |
|   |  |   | 1.65 to 1.95        |                       |      |      | 0.9                          |      |      |
| V <sub>IL</sub>   | Input Voltage Low  |   | 3.6 to 4.3          |                       |      |      |                              | 0.7  | V    |
|   |  |   | 2.7 to 3.6          |                       |      |      |                              | 0.5  | V    |
|   |  |   | 2.3 to 2.7          |                       |      |      |                              | 0.4  |      |
|   |  |   | 1.65 to 1.95        |                       |      |      |                              | 0.4  |      |
| I <sub>IN</sub>   | Control Input Leakage (S1,S2)  | V <sub>IN</sub> =0 to V <sub>CC</sub>   | 1.65 to 4.30        |                       |      |      | -0.5                         | 0.5  | μA   |
| I <sub>NO(OFF)</sub> ,<br>I <sub>NC(OFF)</sub><br>FSA2268 | Off Leakage Current of Port nB0 and nB1                              | nA=0.3V, V <sub>CC</sub> =0.3V<br>nB0 or nB1=V <sub>CC</sub> -0.3V,<br>0.3V, or Floating<br>Figure 6    | 1.95 to 4.30        | -10                   |      | 10   | -50                          | 50   | nA   |
| I <sub>NC(OFF)</sub><br>FSA2268T                          | Off Leakage Current of Port nB0 and nB1 (with Termination Resistors) | nA=0.3V, nB0 or<br>nB1=0V or Floating<br>Figure 6   | 1.95 to 4.30        | -10                   |      | 10   | -50                          | 50   | μA   |
| I <sub>A(ON)</sub>  | On Leakage Current of Port nA  | nA=0.3V, V <sub>CC</sub> =0.3V<br>nB0 or nB1=V <sub>CC</sub> -0.3V,<br>0.3V, or Floating<br>Figure 7    | 1.95 to 4.30        | -20                   |      | 20   | -100                         | 100  | nA   |
| I <sub>OFF</sub><br>FSA2268                               | Power-Off Leakage Current (Common Port Only 1A, 2A)                  | Common Port (1A, 2A),<br>V <sub>IN</sub> =0V to 4.3V, V <sub>CC</sub> =0V<br>nB0, nB1=Floating          | 0V                  |                       |      |      |                              | ±1   | μA   |
| I <sub>OFF</sub><br>FSA2268T                              | Power-Off Leakage Current (Common Port Only 1A, 2A)                  | Common Port (1A, 2A),<br>V <sub>IN</sub> =0V to 4.3V, V <sub>CC</sub> =0V<br>nB0, nB1=0V or<br>Floating | 0V                  |                       |      |      |                              | ±40  | μA   |
| R <sub>ON</sub>   | Switch On Resistance <sup>(2)(5)</sup>                               | I <sub>ON</sub> =100mA, nB0 or<br>nB1=0.7V, 3.6V<br>Figure 5  | 4.30                |                       | 0.30 |      |                              | 0.50 | Ω    |
|   |  | I <sub>ON</sub> =100mA, nB0 or<br>nB1=0.7V, 2.3V<br>Figure 5  | 3.00                |                       | 0.40 |      |                              | 0.55 |      |
|   |  | I <sub>ON</sub> =100mA, nB0 or<br>nB1=0V, 0.7V, 1.6V,<br>2.3V<br>Figure 5                               | 2.30                |                       | 0.52 |      |                              |      |      |
|   |  | I <sub>ON</sub> =100mA, nB0 or<br>nB1=0V, 0.7V, 1.65V<br>Figure 5                                       | 1.65                |                       | 1.00 |      |                              |      |      |
| ΔR <sub>ON</sub>  | On Resistance Matching Between Channels <sup>(3)(5)</sup>            | I <sub>ON</sub> =100mA, nB0 or<br>nB1=0.7V  | 4.30                |                       | 0.04 |      |                              | 0.13 | Ω    |
|   |  |   | 3.00                |                       | 0.06 |      |                              | 0.13 |      |
|   |  |   | 2.30                |                       | 0.12 |      |                              |      |      |
|   |  |   | 1.65                |                       | 1.00 |      |                              |      |      |

Continued on following page...

### DC Electrical Characteristics (Continued)

All 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 to +85°C |      | Unit |
|-----------------------|---|---|---------------------|-----------------------|------|------|------------------------------|------|------|
|                       |   |   |                     | Min.                  | Typ. | Max. | Min.                         | Max. |      |
| R <sub>FLAT(ON)</sub> | On Resistance Flatness <sup>(4)(5)</sup>      | I <sub>OUT</sub> =100mA, nB0 or nB1=0V to V <sub>CC</sub>   | 4.30                |                       |      |      |                              | 0.25 | Ω    |
|                       |   |   | 3.00                |                       |      |      |                              | 0.25 |      |
|                       |   |   | 2.30                |                       | 0.5  |      |                              |      |      |
|                       |   |   | 1.65                |                       | 0.6  |      |                              |      |      |
| R <sub>TERM</sub>     | Internal Termination Resistors <sup>(6)</sup> |   |                     |                       | 200  |      |                              |      | Ω    |
| I <sub>CC</sub>       | Quiescent Supply Current                      | V <sub>IN</sub> =0 or V <sub>CC</sub> , I <sub>OUT</sub> =0 | 4.30                | -100                  |      | 100  | -500                         | 500  | nA   |
| I <sub>CC(T)</sub>    | Increase in I <sub>CC</sub> per Input         | Input at 2.6V   | 4.30                |                       | 3    |      |                              | 7    | μA   |
|                       |   | Input at 1.8V   |                     |                       | 7    |      |                              | 15   |      |

**Notes:**

2. On resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.
3.  $\Delta R_{ON} = R_{ON \max} - R_{ON \min}$  measured at identical V<sub>CC</sub>, temperature, and voltage.
4. Flatness is defined as the difference between the maximum and minimum value of on resistance (R<sub>ON</sub>) over the specified range of conditions.
5. Guaranteed by characterization, not production tested, for V<sub>CC</sub>=1.65-3.00V.
6. Guaranteed by characterization, not production tested.

## AC Electrical Characteristics

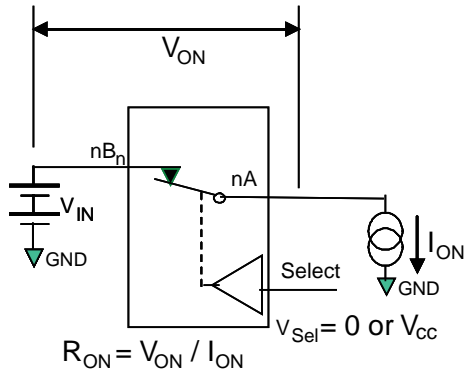
All typical value are for  $V_{CC}=3.3V$  at  $25^{\circ}C$  unless otherwise specified.

| Symbol    | Parameter                 | Conditions  | $V_{CC}$ (V) | $T_A=+25^{\circ}C$ |      |      | $T_A=-40$ to $+85^{\circ}C$ |      | Unit | Figure               |
|-----------|---------------------------|---|--------------|--------------------|------|------|-----------------------------|------|------|----------------------|
|           |                           |   |              | Min.               | Typ. | Max. | Min.                        | Max. |      |                      |
| $t_{ON}$  | Turn-On Time              | nB0 or nB1=1.5V, $R_L=50\Omega$ , $C_L=35pF$            | 3.6 to 4.3   |                    |      | 55   | 15                          | 60   | ns   | Figure 8<br>Figure 9 |
|           |                           |   | 2.7 to 3.6   |                    |      | 60   | 15                          | 65   |      |                      |
|           |                           |   | 2.3 to 2.7   |                    |      | 65   | 15                          | 70   |      |                      |
|           |                           |   | 1.65 to 1.95 |                    | 70   |      |                             |      |      |                      |
| $t_{OFF}$ | Turn-Off Time             | nB0 or nB1=1.5V, $R_L=50\Omega$ , $C_L=35pF$            | 3.6 to 4.3   |                    |      | 30   | 5                           | 35   | ns   | Figure 8<br>Figure 9 |
|           |                           |   | 2.7 to 3.6   |                    |      | 35   | 5                           | 40   |      |                      |
|           |                           |   | 2.3 to 2.7   |                    |      | 40   | 5                           | 45   |      |                      |
|           |                           |   | 1.65 to 1.95 |                    | 40   |      |                             |      |      |                      |
| $t_{BBM}$ | Break-Before-Make Time    | nB0 or nB1=1.5V, $R_L=50\Omega$ , $C_L=35pF$            | 3.6 to 4.3   |                    | 15   |      | 2                           |      | ns   | Figure 10            |
|           |                           |   | 2.7 to 3.6   |                    | 15   |      | 2                           |      |      |                      |
|           |                           |   | 2.3 to 2.7   |                    | 15   |      | 2                           |      |      |                      |
|           |                           |   | 1.65 to 1.95 |                    | 16   |      | 2                           |      |      |                      |
| Q         | Charge Injection          | $C_L=1.0nF$ , $V_S=0V$ , $R_S=0\Omega$                  | 1.65 to 4.30 |                    | 25   |      |                             |      | pC   | Figure 14            |
| OIRR      | Off Isolation             | $f=100kHz$ , $R_L=50\Omega$ , $C_L=0pF$                 | 1.65 to 4.30 |                    | -70  |      |                             |      | dB   | Figure 12            |
| Xtalk     | Crosstalk                 | $f=100kHz$ , $R_L=50\Omega$ , $C_L=0pF$                 | 1.65 to 4.30 |                    | -70  |      |                             |      | dB   | Figure 13            |
| BW        | -3db Bandwidth            | $R_L=50\Omega$ , $C_L=0pF$                              | 1.65 to 4.30 |                    | >50  |      |                             |      | MHz  | Figure 11            |
| THD       | Total Harmonic Distortion | $f=20Hz$ to $20kHz$ , $R_L=32\Omega$ , $V_{IN}=2V_{pp}$ | 1.65 to 4.30 |                    | .06  |      |                             |      | %    | Figure 17            |

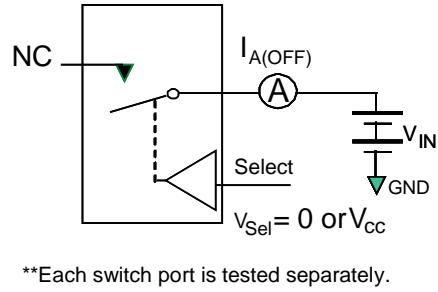
## Capacitance

| Symbol    | Parameter                     | Conditions | $V_{CC}$ (V) | $T_A=+25^{\circ}C$ |      |      | Unit | Figure    |
|-----------|-------------------------------|------------|--------------|--------------------|------|------|------|-----------|
|           |                               |            |              | Min.               | Typ. | Max. |      |           |
| $C_{IN}$  | Control Pin Input Capacitance | $f=1MHz$   | 0            |                    | 1.5  |      | pF   | Figure 15 |
| $C_{OFF}$ | B Port Off Capacitance        | $f=1MHz$   | 3.3          |                    | 30   |      | pF   | Figure 15 |
| $C_{ON}$  | A Port On Capacitance         | $f=1MHz$   | 3.3          |                    | 120  |      | pF   | Figure 16 |

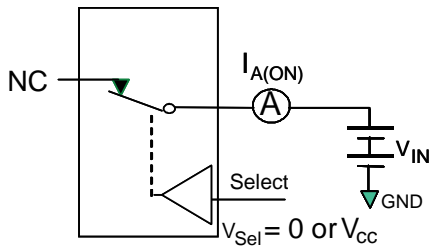
### Test Diagrams



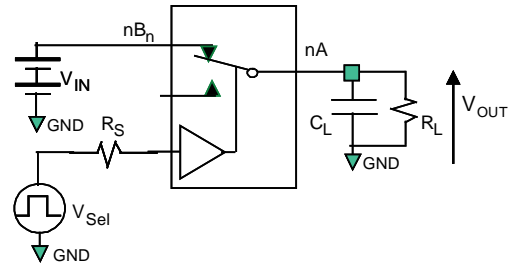
**Figure 5. On Resistance**



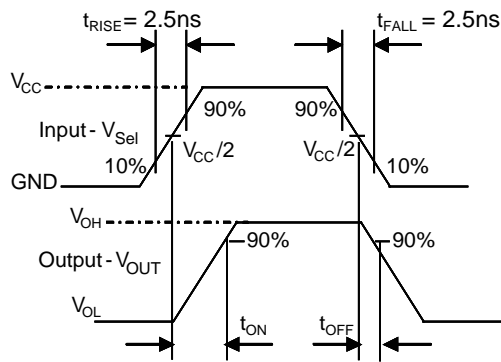
**Figure 6. Off Leakage (Ports tested separately)**



**Figure 7. On Leakage**



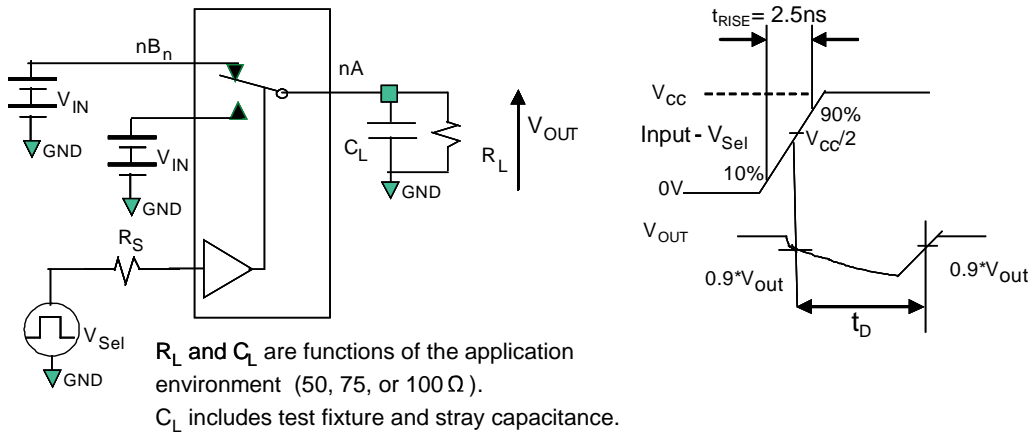
**Figure 8. Test Circuit Load**



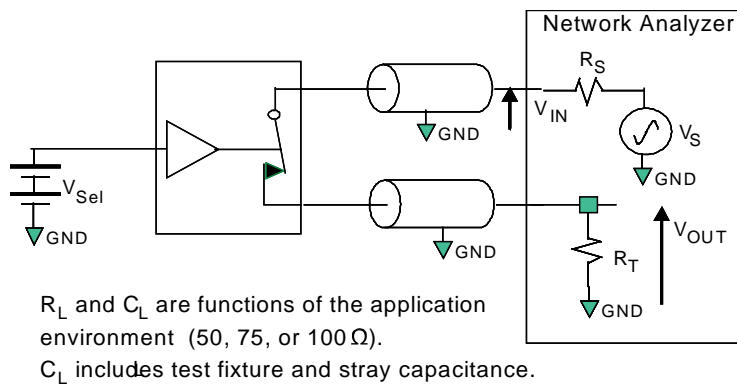
**Figure 9. Turn-On / Turn-Off Waveforms**



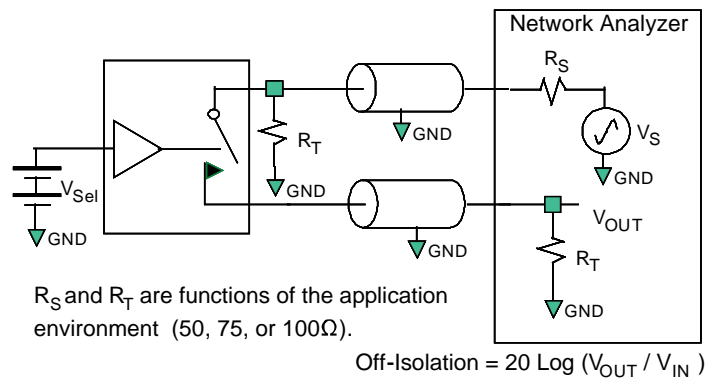
**Test Diagrams (Continued)**



**Figure 10. Break-Before-Make Interval Timing**

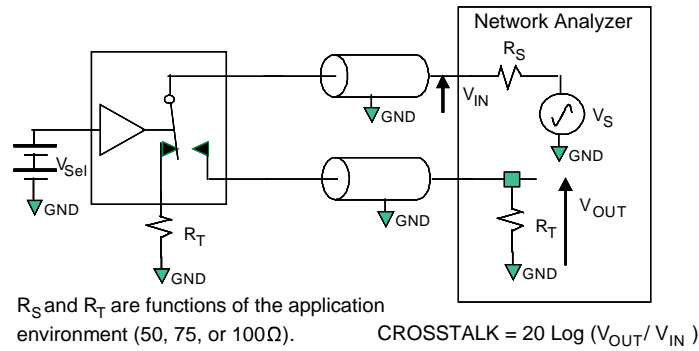


**Figure 11. Bandwidth**

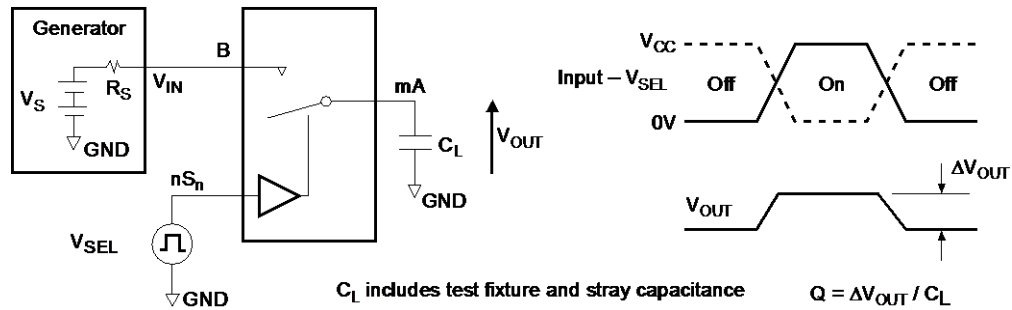


**Figure 12. Channel Off Isolation**

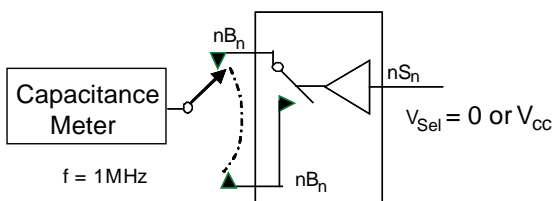
**Test Diagrams (Continued)**



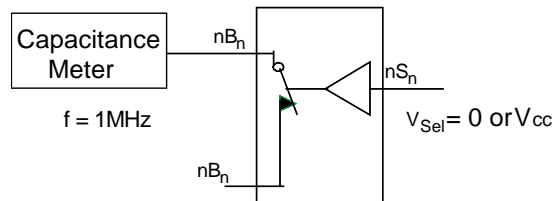
**Figure 13. Adjacent Channel Crosstalk**



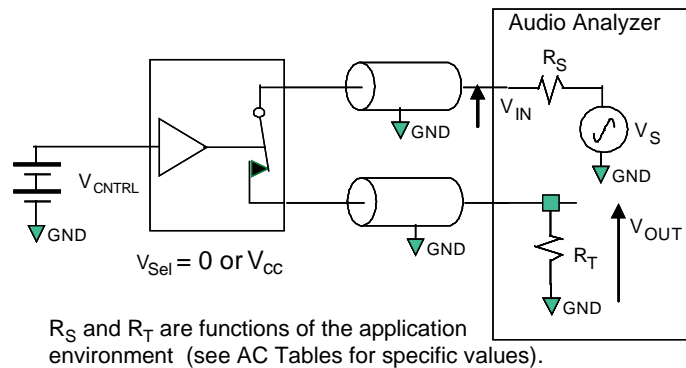
**Figure 14. Charge Injection Test**



**Figure 15. Channel Off Capacitance**

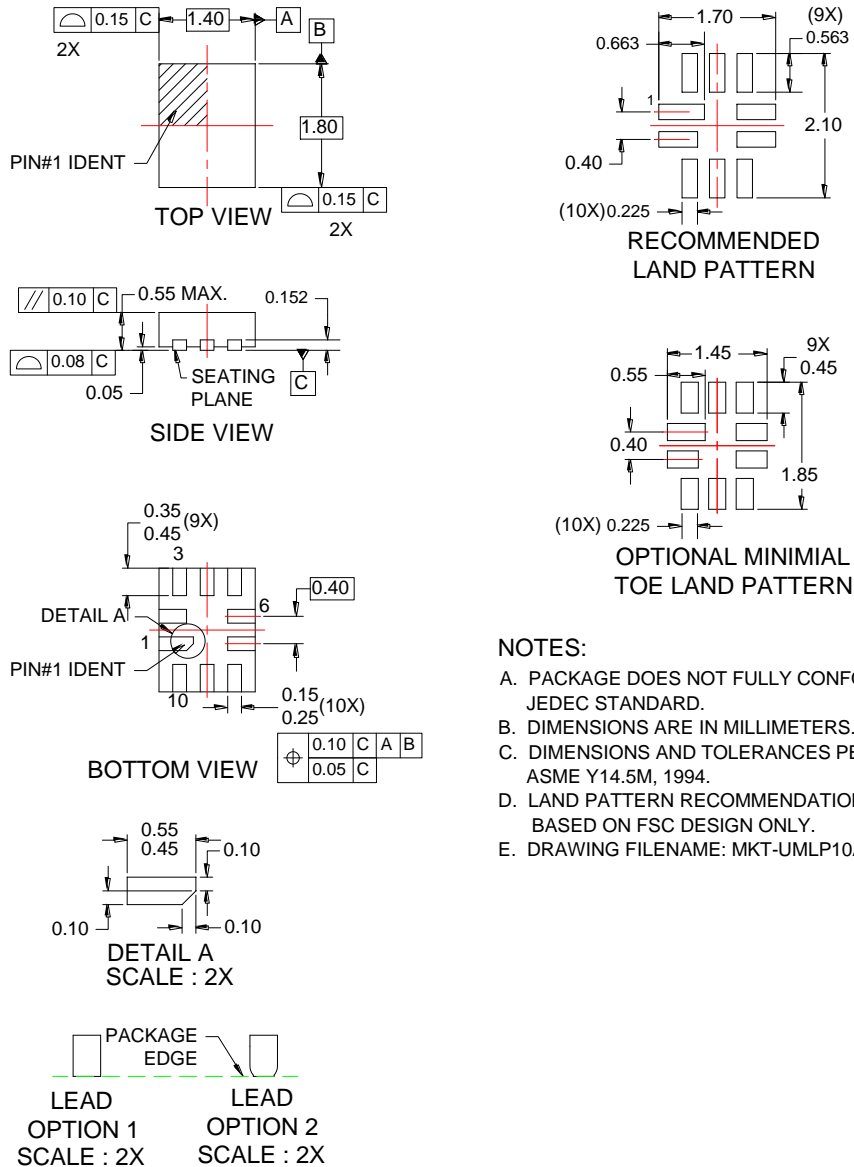


**Figure 16. Channel On Capacitance**



**Figure 17. Total Harmonic Distortion**

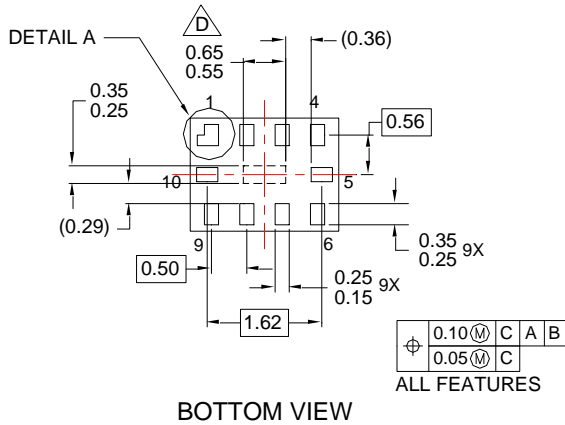
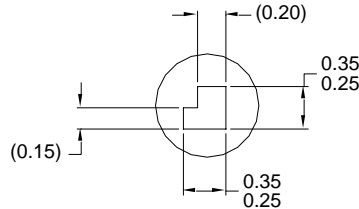
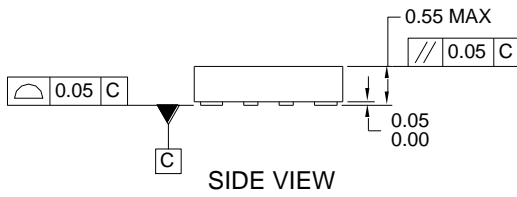
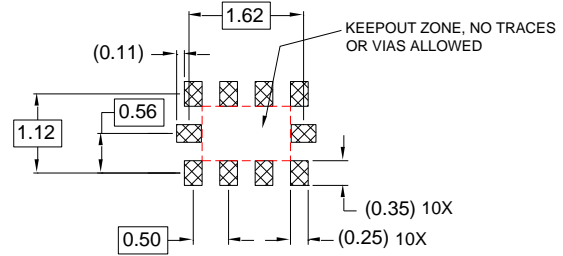
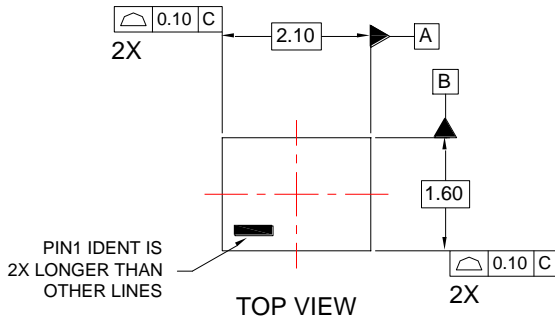
## Physical Dimensions



**Figure 18. 10-Lead Quad Ultrathin Molded Leadless Package (UMLP)**

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**Physical Dimensions (Continued)**



**NOTES:**

- A. PACKAGE CONFORMS TO JEDEC REGISTRATION MO-255, VARIATION UABD.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
- D. PRESENCE OF CENTER PAD IS PACKAGE SUPPLIER DEPENDENT. IF PRESENT IT IS NOT INTENDED TO BE SOLDERED AND HAS A BLACK OXIDE FINISH.
- E. DRAWING FILENAME: MKT-MAC10Arev5.

**Figure 19. 10-Lead, MicroPak™, 1.6mm Wide**

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