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FSA2269 / FSA2269TS — Low-Voltage Dual-SPDT (0.4 Ω) Analog Switch with Negative Swing Audio Capability

Features

- 0.4 Ω Typical On Resistance (R_{ON}) for +3.0 V Supply
- 0.25 Ω Maximum R_{ON} Flatness for +3.0 V Supply
- -3 db Bandwidth: > 50 MHz
- Low- I_{CCT} Current Over an Expanded Control Input Range
- Packaged in 10-Lead MicroPak™, UMLP, and WLCSP
- Power-Off Protection on Common Ports
- Broad V_{CC} Operating Range: 1.65 to 4.5 V
- Noise Immunity Termination Resistors in FSA2269TS

Applications

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

Description

The FSA2269 is a high-performance, dual Single-Pole Double-Throw (SPDT) analog switch with negative swing audio capability. The FSA2269 features ultra-low R_{ON} of 0.4 Ω (typical) at 3.0 V V_{CC} . The FSA2269 operates over a wide V_{CC} range of 1.65 V to 4.5 V, 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 FSA2269 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 FSA2269TS includes termination resistors that improve noise immunity during overshoot excursions, off-isolation coupling, or “pop-minimization.”

Ordering Information

| Part Number | Top Mark | Package Description |
|---------------|----------|--|
| FSA2269L10X | HL | 10-Lead, MicroPak, JEDEC MO-255, 1.6 x 2.1 mm |
| FSA2269UMX | HP | 10-Lead, Quad Ultrathin Molded Leadless Package (UMLP), 1.4 x 1.8 mm, 0.4 mm Pitch |
| FSA2269TSL10X | HU | 10-Lead, MicroPak, JEDEC MO-255, 1.6 x 2.1 mm |
| FSA2269TSUMX | HT | 10-Lead, Quad Ultrathin Molded Leadless Package (UMLP), 1.4 x 1.8 mm, 0.4 mm Pitch |
| FSA2269UCX | N9 | 12-Ball, Wafer-Level Chip Scale Package (WLCSP), 1.2 x 1.6 mm, 0.4 mm Pitch |

Analog Symbols

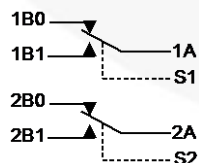


Figure 1. FSA2269

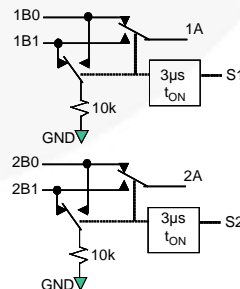


Figure 2. FSA2269TS (with Slow Turn On)

Pin Configuration

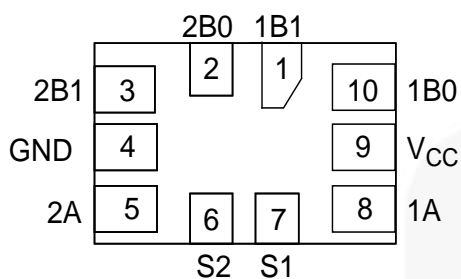


Figure 3. 10-Pin UMLP (Top Through View)

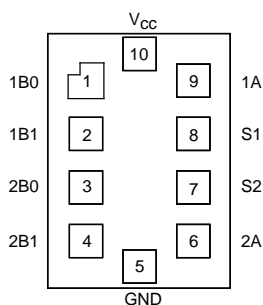


Figure 4. 10-Pin MicroPak™ (Top Through View)

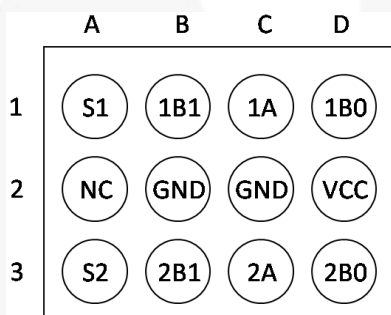


Figure 5. 12-Ball WLCSP (Bump Side View)

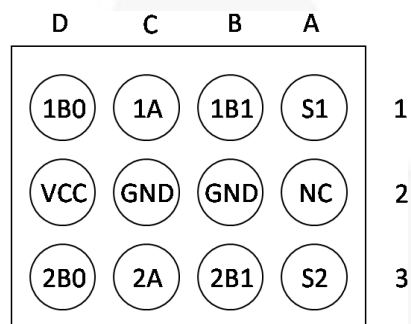


Figure 6. 12-Ball WLCSP (Top Side View)

Pin Descriptions

| Pin # UMLP | Pin # Micropak | WLCSP | Name | Description |
|------------|----------------|--------|-----------------|--------------------|
| 1 | 2 | B1 | 1B1 | Data Ports |
| 2 | 3 | D3 | 2B0 | Data Ports |
| 3 | 4 | B3 | 2B1 | Data Ports |
| 4 | 5 | B2, C2 | GND | Ground |
| 5 | 6 | C3 | 2A | Data Ports |
| 6 | 7 | A3 | S2 | Switch Select Pins |
| 7 | 8 | A1 | S1 | Switch Select Pins |
| 8 | 9 | C1 | 1A | Data Ports |
| 9 | 10 | D2 | V _{CC} | Supply Voltage |
| 10 | 1 | D1 | 1B0 | Data Ports |

Truth Table

| Control Input, S _n | Function |
|-------------------------------|--|
| LOW Logic Level | nB0 connected to nA (FSA2269/2269TS); nB1 terminated to GND (FSA2269TS only) |
| HIGH Logic Level | nB1 connected to nA (FSA2269/2269TS); nB0 terminated to GND (FSA2269TS only) |

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. Functional operation above the recommended operating conditions is not implied. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. Absolute maximum ratings are stress ratings only.

| Symbol | Parameter | | Min. | Max. | Unit |
|---------------------|--|---|----------------------|----------------------|------|
| V _{CC} | Supply Voltage | | -0.5 | 5.5 | V |
| V _{SW} | Switch I/O Voltage ⁽¹⁾ | 1B0, 1B1, 2B0, 2B1, 1A, 2A Pins | V _{CC} -4.6 | 5.5 | V |
| V _{CNTRL} | Control Input Voltage ⁽¹⁾ | S1, S2 | -0.5 | V _{CC} +0.3 | V |
| 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 | | |
| ESD | Human Body Model, JEDEC: JESD22-A114 | I/O to GND | | 12 | kV |
| | | I/O to GND FSA2269UCX | | 11 | |
| | | Power to GND | | 8 | |
| | | All Other Pins | | 7 | |
| | Charged Device Model, JEDEC: JESD22-C101 | | | 2 | |

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 _{CC} | Supply Voltage ⁽²⁾ | 1.65 | 4.50 | V |
| V _{S1, S2} | Control Input Voltage | 0V | V _{CC} | V |
| V _{SW} | Switch I/O Voltage | V _{CC} -4.3 | V _{CC} | V |
| T _A | Operating Temperature | -40 | +85 | °C |

Note:

2. For 4.5 V operation, SEL frequency (pins S1 & S2) should not exceed 100 Hz and 50 ns edge rate.

DC Electrical CharacteristicsAll typical values are $T_A=25^\circ\text{C}$ unless otherwise specified.

| Symbol | Parameter | Conditions | V_{CC} (V) | $T_A=+25^\circ\text{C}$ | | | $T_A=-40$ to $+85^\circ\text{C}$ | | Unit |
|----------------------------|---|--|--------------|-------------------------|------|------|----------------------------------|----------|---------------|
| | | | | Min. | Typ. | Max. | Min. | Max. | |
| V_{IH} | Input Voltage High | | 3.60 to 4.50 | | | | 1.70 | | V |
| | | | 3.00 to 3.60 | | | | 1.50 | | |
| | | | 2.70 to 3.00 | | | | 1.35 | | |
| | | | 2.30 to 2.70 | | | | 1.30 | | |
| | | | 1.65 to 1.95 | | | | 0.90 | | |
| V_{IL} | Input Voltage Low | | 3.60 to 4.50 | | | | | 0.7 | V |
| | | | 2.70 to 3.60 | | | | | 0.5 | V |
| | | | 2.30 to 2.70 | | | | | 0.4 | |
| | | | 1.65 to 1.95 | | | | | 0.4 | |
| I_{IN} | Control Input Leakage (S1, S2) | $V_{IN}=0$ to V_{CC} | 1.65 to 4.50 | | | | -0.5 | 0.5 | μA |
| $I_{NO(OFF)}, I_{NC(OFF)}$ | Off Leakage Current of Port nB0 and nB1 (FSA2269 only) | $nA=0.5$ V, $V_{CC}=0.5$ V nB0 or nB1= $V_{CC}-0.5$ V, 0.5 V, or Floating Figure 8 | 1.95 to 4.50 | -50 | | 50 | -250 | 250 | nA |
| $I_{A(ON)}$ | On Leakage Current of Port nA | $nA=0.5$ V, $V_{CC}=0.5$ V nB0 or nB1= $V_{CC}-0.5$ V, 0.5 V, or Floating Figure 9 | 1.95 to 4.50 | -20 | | 20 | -150 | 150 | nA |
| I_{OFF} | Power-Off Leakage Current (Common Port Only 1A, 2A) (FSA2269) | Common Port (1A, 2A), $V_{IN}=0$ V to 4.5 V, $V_{CC}=0$ V nB0, nB1=Floating | 0 | | | | | ± 1 | μA |
| | Power-Off Leakage Current (Common Port Only 1A, 2A) (FSA2269TS) | Common Port (1A, 2A), $V_{IN}=0$ V to 4.5 V, $V_{CC}=0$ V nB0, nB1=0 V or Floating | 0 | | | | | ± 45 | μA |
| R_{ON} | Switch On Resistance ^(3,6) | $I_{ON}=100$ mA, nB0 or nB1=0.7 V, 3.6 V, 4.5 V, Figure 7 | 4.50 | | 0.30 | | | | Ω |
| | | $I_{ON}=100$ mA, nB0 or nB1=0.7 V, 3.6 V, Figure 7 | 3.00 | | 0.40 | | | 0.80 | |
| | | $I_{ON}=100$ mA, nB0 or nB1=0V, 0.7 V, 1.6 V, 2.3 V, Figure 7 | 2.30 | | 0.52 | | | | |
| | | $I_{ON}=100$ mA, nB0 or nB1=0V, 0.7 V, 1.65 V, Figure 7 | 1.65 | | 1.00 | | | | |
| ΔR_{ON} | On Resistance Matching Between Channels ⁽⁴⁾ | $I_{ON}=100$ mA, nB0 or nB1=0.7 V | 4.50 | | 0.04 | | | 0.13 | Ω |
| | | | 3.00 | | 0.06 | | | 0.13 | |
| | | | 2.30 | | 0.12 | | | | |
| | | | 1.65 | | 1.00 | | | | |

Continued on the following page...

DC Electrical Characteristics (Continued)All typical values are $T_A=25^\circ\text{C}$ unless otherwise specified.

| Symbol | Parameter | Conditions | V_{CC} (V) | $T_A=+25^\circ\text{C}$ | | | $T_A=-40$ to $+85^\circ\text{C}$ | | Unit |
|-----------------------|--|--|--------------|-------------------------|------|------|----------------------------------|------|---------------|
| | | | | Min. | Typ. | Max. | Min. | Max. | |
| $R_{\text{FLAT(ON)}}$ | On Resistance Flatness ⁽⁵⁾ | $I_{\text{OUT}}=100\text{ mA}$, nB0 or nB1=0V to V_{CC} | 4.50 | | | | | 0.25 | Ω |
| | | | 3.00 | | | | | 0.25 | |
| | | | 2.30 | | 0.5 | | | | |
| | | | 1.65 | | 0.6 | | | | |
| R_{TERM} | Internal Termination Resistors ⁽⁶⁾ (FSA2269TS only) | | | | 10 | | | | k Ω |
| I_{CC} | Quiescent Supply Current | $V_{\text{IN}}=0$ or V_{CC} , $I_{\text{OUT}}=0$ | 4.50 | -100 | | 100 | -500 | 500 | nA |
| I_{CCT} | Increase in I_{CC} per Input | Input at 2.6 V | 4.50 | | 3.0 | | | 10.0 | μA |
| | | Input at 1.8 V | | | 7.0 | | | 15.0 | |

Notes:

- On resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.
- $\Delta R_{\text{ON}}=R_{\text{ON max}} - R_{\text{ON min}}$ measured at identical V_{CC} , temperature, and voltage.
- Flatness is defined as the difference between the maximum and minimum value of on resistance (R_{ON}) over the specified range of conditions.
- Guaranteed by characterization, not production tested.

AC Electrical Characteristics

All typical value are $T_A=25^\circ\text{C}$ unless otherwise specified.

| Symbol | Parameter | Conditions | V_{CC} (V) | $T_A=+25^\circ\text{C}$ | | | $T_A=-40$ to $+85^\circ\text{C}$ | | Unit | Figure |
|-----------|---|---|--------------|-------------------------|------|------|----------------------------------|------|---------------|------------------------|
| | | | | Min. | Typ. | Max. | Min. | Max. | | |
| t_{ON} | Turn-On Time FSA2269 | nB0 or nB1=1.5 V, $R_L=50\ \Omega$, $C_L=35\ \text{pF}$ | 3.60 to 4.50 | | | 55 | 15 | 60 | ns | Figure 10 Figure 11 |
| | | | 2.70 to 3.60 | | | 60 | 15 | 65 | | |
| | | | 2.30 to 2.70 | | | 100 | 15 | 110 | | |
| | | | 1.65 to 1.95 | | 70 | | | | | |
| | Turn-On Time FSA2269UCX | nB0 or nB1=1.5 V, $R_L=50\ \Omega$, $C_L=35\ \text{pF}$ | 3.60 to 4.50 | | | 105 | 15 | 110 | ns | Figure 10 Figure 11 |
| | | | 2.70 to 3.60 | | | 115 | 15 | 150 | | |
| | | | 2.30 to 2.70 | | | 180 | 15 | 185 | | |
| | | | 1.65 to 1.95 | | 110 | | | | | |
| | Turn-On Time FSA2269TS | nB0 or nB1=1.5 V, $R_L=50\ \Omega$, $C_L=35\ \text{pF}$ | 3.60 to 4.50 | | | 3.5 | 0.5 | 4.0 | μs | Figure 10 Figure 11 |
| | | | 2.70 to 3.60 | | | 4.5 | 0.5 | 5.0 | | |
| | | | 2.30 to 2.70 | | | 6.0 | 0.5 | 7.0 | | |
| | | | 1.65 to 1.95 | | 8.0 | | | | | |
| t_{OFF} | Turn-Off Time FSA2269 | nB0 or nB1=1.5 V, $R_L=50\ \Omega$, $C_L=35\ \text{pF}$ | 3.60 to 4.50 | | | 50 | 5 | 55 | ns | Figure 10 Figure 11 |
| | | | 2.70 to 3.60 | | | 55 | 5 | 60 | | |
| | | | 2.30 to 2.70 | | | 60 | 5 | 65 | | |
| | | | 1.65 to 1.95 | | 40 | | | | | |
| | Turn-Off Time FSA2269UCX | nB0 or nB1=1.5 V, $R_L=50\ \Omega$, $C_L=35\ \text{pF}$ | 3.60 to 4.50 | | | 100 | 5 | 105 | ns | Figure 10 Figure 11 |
| | | | 2.70 to 3.60 | | | 110 | 5 | 115 | | |
| | | | 2.30 to 2.70 | | | 120 | 5 | 125 | | |
| | | | 1.65 to 1.95 | | 80 | | | | | |
| | Turn-Off Time FSA2269TS | nB0 or nB1=1.5 V, $R_L=50\ \Omega$, $C_L=35\ \text{pF}$ | 3.60 to 4.50 | | | 45 | 5 | 50 | ns | Figure 10 Figure 11 |
| | | | 2.70 to 3.60 | | | 50 | 5 | 55 | | |
| | | | 2.30 to 2.70 | | | 55 | 5 | 60 | | |
| | | | 1.65 to 1.95 | | 50 | | | | | |
| t_{BBM} | Break-Before-Make Time FSA2269 ⁽⁷⁾ | nB0 or nB1=1.5 V, $R_L=50\ \Omega$, $C_L=35\ \text{pF}$ | 3.60 to 4.50 | | 3 | | 1 | | ns | Figure 12 |
| | | | 2.70 to 3.60 | | 5 | | 2 | | | |
| | | | 2.30 to 2.70 | | 10 | | 2 | | | |
| | | | 1.65 to 1.95 | | 5 | | 2 | | | |
| t_{BBM} | Break-Before-Make Time FSA2269UCX ⁽⁷⁾ | nB0 or nB1=1.5 V, $R_L=50\ \Omega$, $C_L=35\ \text{pF}$ | 3.60 to 4.50 | | 9.5 | | 5.5 | | ns | Figure 12 |
| | | | 2.70 to 3.60 | | 17.0 | | 15.0 | | | |
| | | | 2.30 to 2.70 | | 22.0 | | 20.0 | | | |
| | | | 1.65 to 1.95 | | 46.0 | | 41.0 | | | |
| t_{BBM} | Break-Before-Make Time FSA2269TS ⁽⁷⁾ | nB0 or nB1=1.5 V, $R_L=50\ \Omega$, $C_L=35\ \text{pF}$ | 3.60 to 4.50 | | 1.5 | | 1.0 | | μs | Figure 12 |
| | | | 2.70 to 3.60 | | 3.0 | | 1.5 | | | |
| | | | 2.30 to 2.70 | | 4.0 | | 2.5 | | | |
| | | | 1.65 to 1.95 | | 5.0 | | 3.0 | | | |

Continued on the following page...

AC Electrical Characteristics (Continued)All typical value are $T_A=25^\circ\text{C}$ unless otherwise specified.

| Symbol | Parameter | Conditions | V_{CC} (V) | $T_A=+25^\circ\text{C}$ | | | $T_A=-40$ to $+85^\circ\text{C}$ | | Unit | Figure |
|--------|---------------------------|--|--------------|-------------------------|------|------|----------------------------------|------|------|-----------|
| | | | | Min. | Typ. | Max. | Min. | Max. | | |
| Q | Charge Injection | $C_L=1.0\text{ nF}$, $V_S=0\text{ V}$, $R_S=0\ \Omega$ | 1.65 to 4.50 | | 25 | | | | pC | Figure 16 |
| OIRR | Off Isolation | $f=100\text{ kHz}$, $R_L=50\ \Omega$, $C_L=0\text{ pF}$ | 1.65 to 4.50 | | -70 | | | | dB | Figure 14 |
| Xtalk | Crosstalk | $f=100\text{ kHz}$, $R_L=50\ \Omega$, $C_L=0\text{ pF}$ | 1.65 to 4.50 | | -70 | | | | dB | Figure 15 |
| BW | -3db Bandwidth | $R_L=50\ \Omega$, $C_L=0\text{ pF}$ | 1.65 to 4.50 | | >50 | | | | MHz | Figure 13 |
| THD | Total Harmonic Distortion | $f=20\text{ Hz to }20\text{ kHz}$, $R_L=32\ \Omega$, $V_{IN}=2\text{ V}_{PP}$, $V_{BIAS}=0\text{ V}$ | 1.65 to 4.50 | | .06 | | | | % | Figure 19 |

Notes:

7. Guaranteed by characterization, not production tested.

Capacitance

| Symbol | Parameter | Conditions | V_{CC} (V) | $T_A=+25^\circ\text{C}$ | | | Unit | Figure |
|-----------|-------------------------------|------------------|--------------|-------------------------|------|------|------|-----------|
| | | | | Min. | Typ. | Max. | | |
| C_{IN} | Control Pin Input Capacitance | $f=1\text{ MHz}$ | 0 | | 2.5 | | pF | Figure 17 |
| C_{OFF} | B Port Off Capacitance | $f=1\text{ MHz}$ | 3.3 | | 30 | | pF | Figure 17 |
| C_{ON} | A Port On Capacitance | $f=1\text{ MHz}$ | 3.3 | | 120 | | pF | Figure 18 |

Test Diagrams

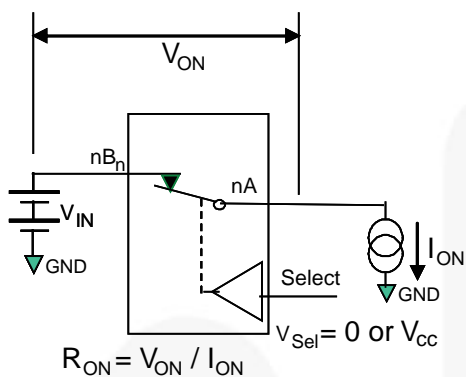
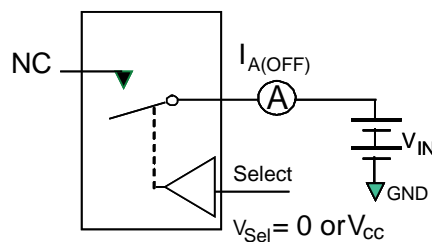


Figure 7. On Resistance



**Each switch port is tested separately.

Figure 8. Off Leakage

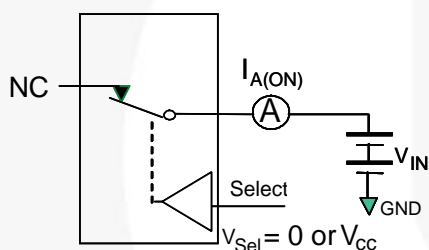


Figure 9. On Leakage

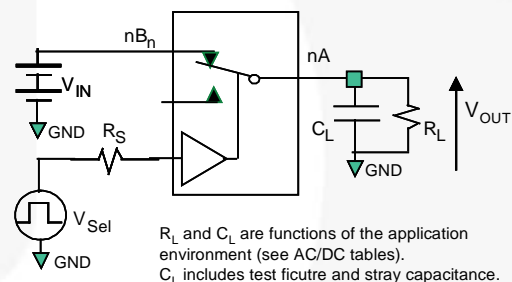


Figure 10. Test Circuit Load

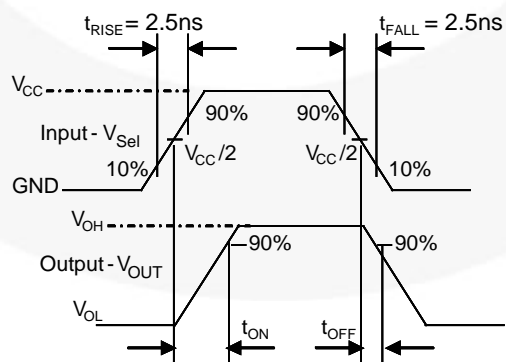


Figure 11. Turn-On / Turn-Off Waveforms

Test Diagrams (Continued)

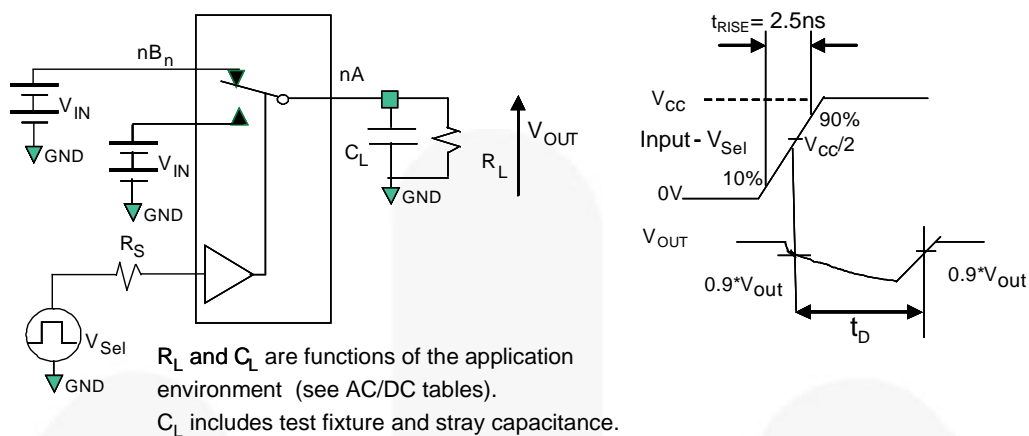


Figure 12. Break-Before-Make Interval Timing

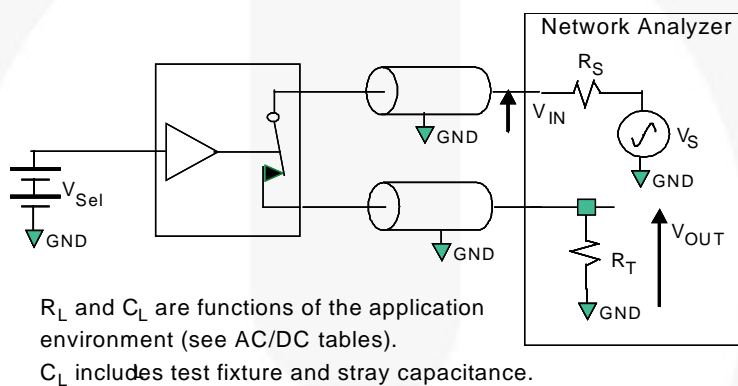


Figure 13. Bandwidth

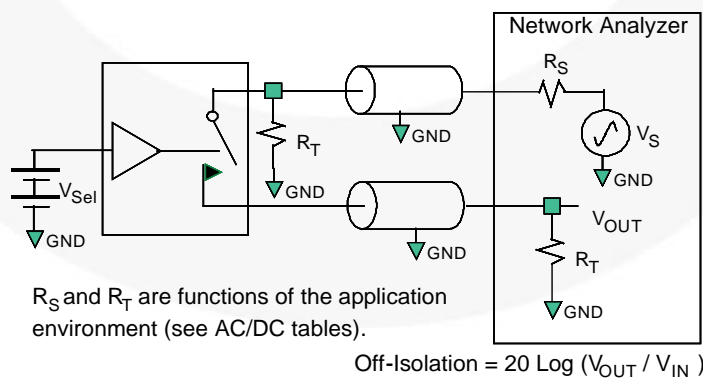


Figure 14. Channel Off Isolation

Test Diagrams (Continued)

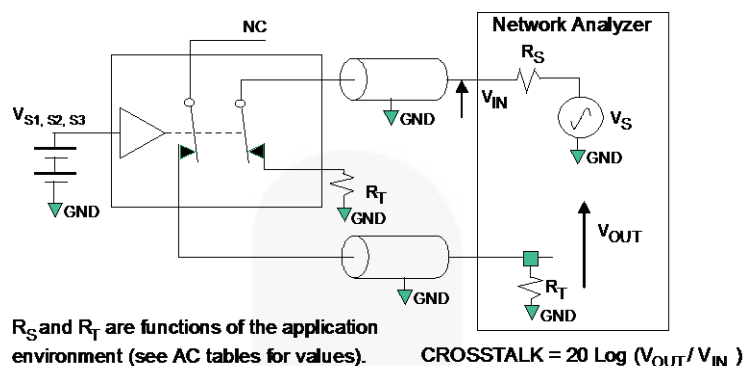


Figure 15. Adjacent Channel Crosstalk

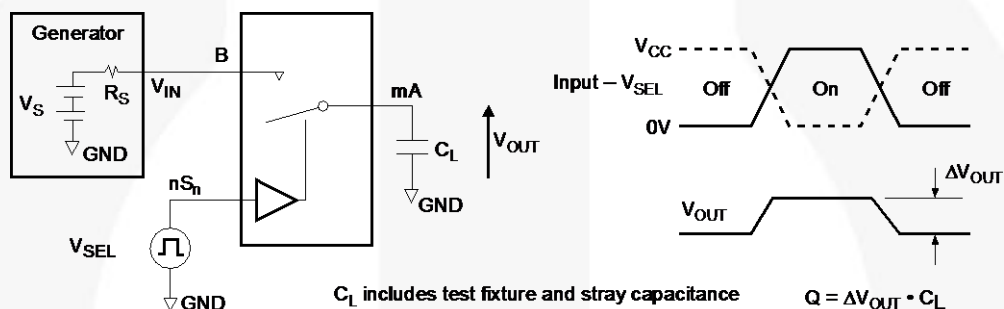


Figure 16. Charge Injection Test

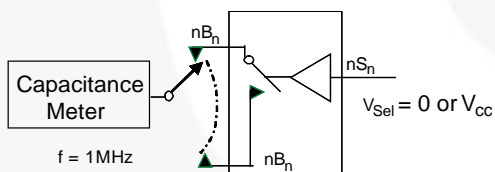


Figure 17. Channel Off Capacitance

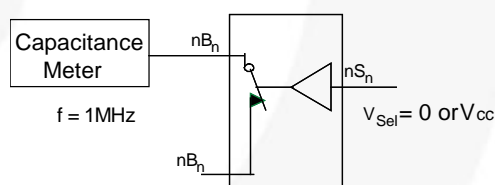


Figure 18. Channel On Capacitance

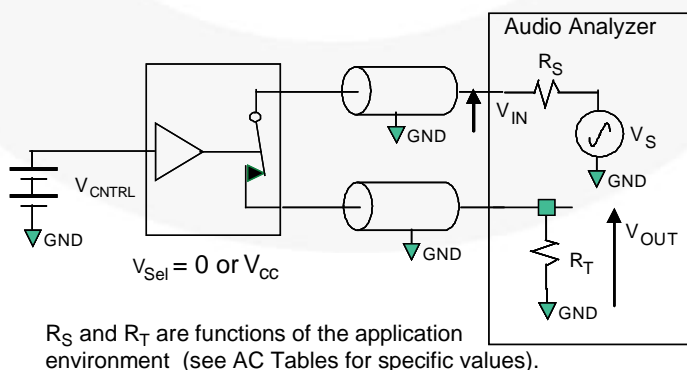


Figure 19. Total Harmonic Distortion

Physical Dimensions

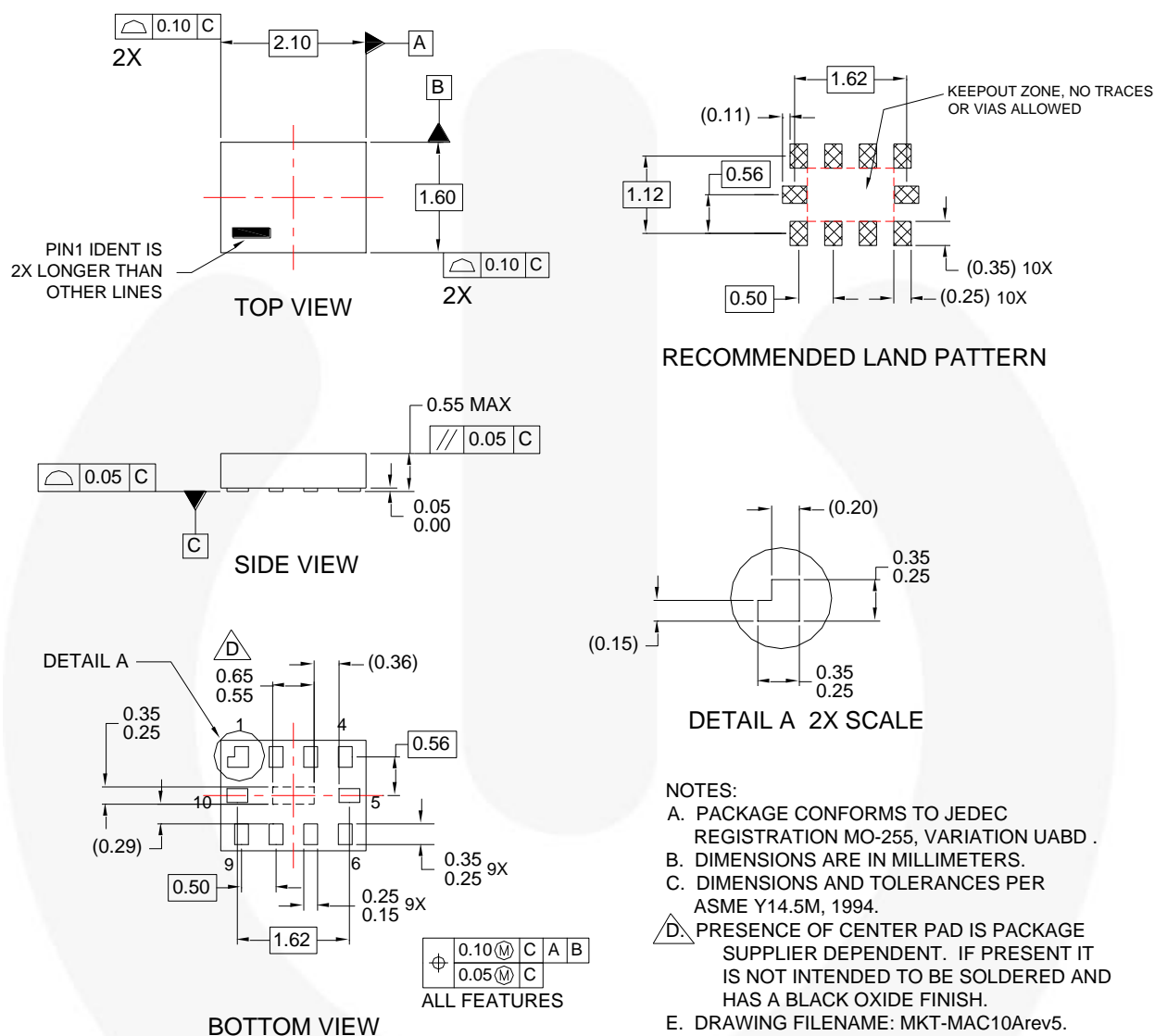


Figure 20. 10-Lead MicroPak™

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Physical Dimensions (Continued)

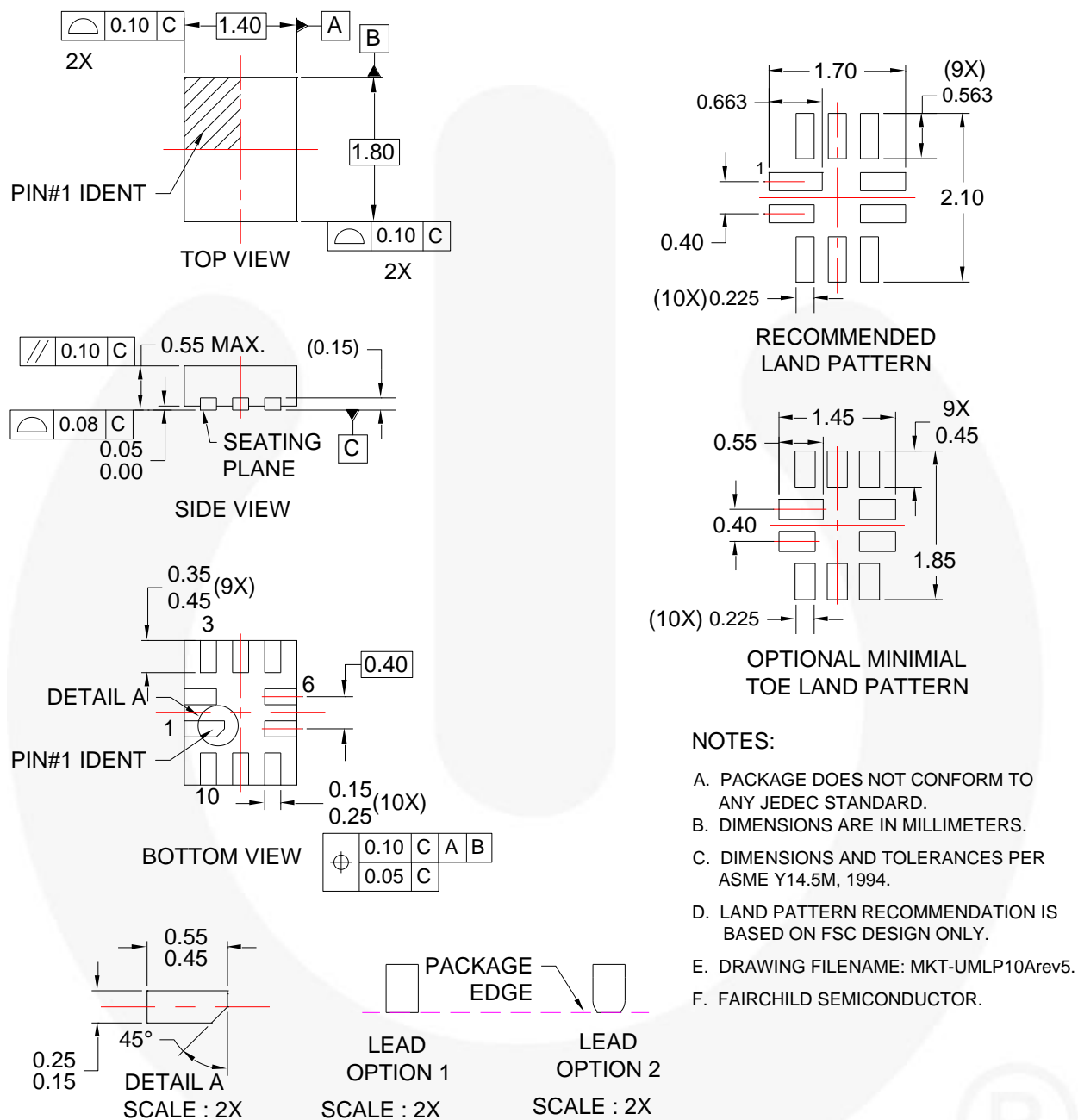
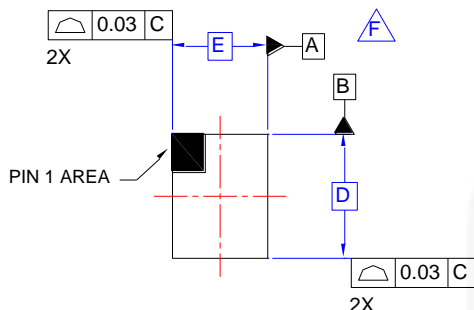
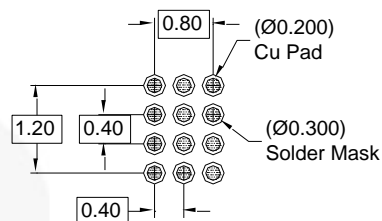
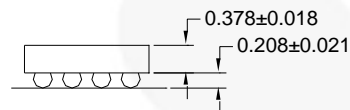
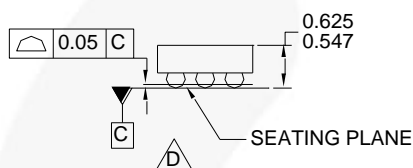
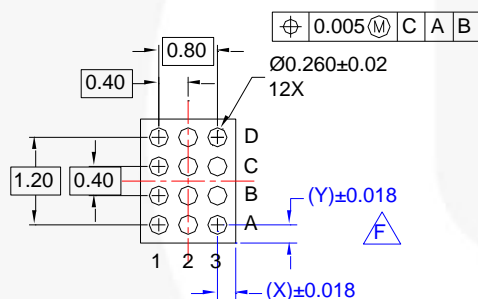


Figure 21. 10-Lead, Quad Ultrathin Molded Leadless Package (UMLP)

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Physical Dimensions (Continued)**TOP VIEW****RECOMMENDED LAND PATTERN
(NSMD PAD TYPE)****SIDE VIEWS****BOTTOM VIEW****NOTES:**

- A. NO JEDEC REGISTRATION APPLIES.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
- D. DATUM C IS DEFINED BY THE SPHERICAL CROWNS OF THE BALLS.
- E. PACKAGE NOMINAL HEIGHT IS 586 MICRONS ± 39 MICRONS (547-625 MICRONS).
- F. FOR DIMENSIONS D, E, X, AND Y SEE PRODUCT DATASHEET.
- G. DRAWING FILENAME: MKT-UC012ACrev1.

Product-Specific Dimensions

| Product | D | E | X | Y |
|------------|----------|----------|----------|----------|
| FSA2269UCX | 1.560 mm | 1.160 mm | 0.180 mm | 0.180 mm |

Figure 22. 12-Ball, Wafer Level Chip-Scale Package (WLCSP)

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