

# FSA2259 Low-Voltage, Dual-SPDT (0.8Ω) Analog Switch with 16kV ESD

## Features

- 0.8Ω Typical On Resistance ( $R_{ON}$ ) for +3.0V Supply
- 0.40Ω Maximum  $R_{ON}$  Flatness for +3.0V Supply
- -3db Bandwidth: > 50MHz
- Low  $I_{CCT}$  Current Over an Expanded Control Input Range
- Packaged in 10-Lead UMLP (1.4 x 1.8mm)
- Power-Off Protection on Common Ports
- Broad  $V_{CC}$  Operating Range: 1.65 to 4.4V
- ESD HBM JEDEC: JESD22-A114
  - I/O to GND: 8.5kV
  - Power to GND: 16.0kV

## Applications

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

## Description

The FSA2259 is a high-performance, dual, Single Pole Double Throw (SPDT) analog switch that features low  $R_{ON}$  of 0.8Ω (typical) at 3.0V  $V_{CC}$ . The FSA2259 operates over a wide  $V_{CC}$  range of 1.65V to 4.4V and is designed for break-before-make operation. The select input is TTL-level compatible.

The FSA2259 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.

## Related Resources

For additional information, please contact [analogswitch@fairchildsemi.com](mailto:analogswitch@fairchildsemi.com).

## Ordering Information

| Part Number | Top Mark | Operating Temperature Range | Package                                                              |
|-------------|----------|-----------------------------|----------------------------------------------------------------------|
| FSA2259UMX  | JT       | -40 to +85°C                | 10-Lead, Quad, Ultrathin Molded Leadless Package (UMLP), 1.4 x 1.8mm |

## Analog Symbol

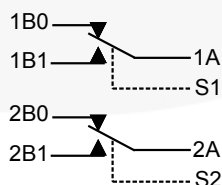


Figure 1. FSA2259

## Pin Configuration

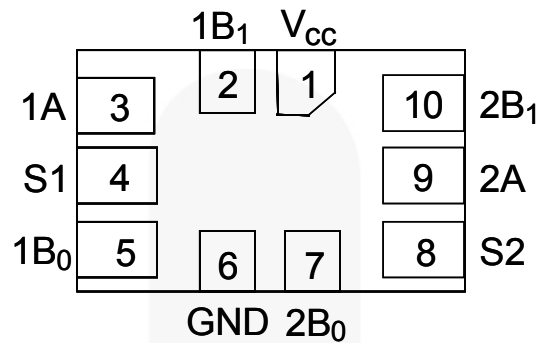


Figure 2. 10-Pin UMLP (Top Through View)

## Pin Description

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

## Truth Table

| Control Input, S <sub>n</sub> | Function                        |
|-------------------------------|---------------------------------|
| LOW Logic Level               | nB <sub>0</sub> Connected to nA |
| HIGH Logic Level              | nB <sub>1</sub> Connected to nA |

## 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     |
| $V_{IN}$     | Control Input Voltage <sup>(1)</sup>                          | S1, S2                          | -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    |
| ESD          | Human Body Model, JEDEC: JESD22-A114                          | I/O to GND                      |      | 8.5            | kV    |
|              |                                                               | Power to GND                    |      | 16.0           |       |
|              |                                                               | All Other Pins                  |      | 8.0            |       |
|              | Charged Device Model, JEDEC: JESD22-C101                      |                                 |      | 2.0            | kV    |

**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.     | Units |
|----------|-----------------------|------|----------|-------|
| $V_{CC}$ | Supply Voltage        | 1.65 | 4.40     | 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>                                | Control Input Voltage High                               |                                                                                                      | 3.60 to 4.30        |                       |      |      | 1.7                          |      | V    |
|                                                |                                                          |                                                                                                      | 2.70 to 3.60        |                       |      |      | 1.5                          |      |      |
|                                                |                                                          |                                                                                                      | 2.30 to 2.70        |                       |      |      | 1.4                          |      |      |
|                                                |                                                          |                                                                                                      | 1.65 to 1.95        |                       |      |      | 0.9                          |      |      |
| V <sub>IL</sub>                                | Control Input Voltage Low                                |                                                                                                      | 3.60 to 4.30        |                       |      |      |                              | 0.7  | V    |
|                                                |                                                          |                                                                                                      | 2.70 to 3.60        |                       |      |      |                              | 0.5  |      |
|                                                |                                                          |                                                                                                      | 2.30 to 2.70        |                       |      |      |                              | 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> | 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 4 | 1.95 to 4.30        | -10                   |      | 10   | -50                          | 50   | nA   |
| 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 5 | 1.95 to 4.30        | -20                   |      | 20   | -100                         | 100  | nA   |
| I <sub>OFF</sub>                               | Power-Off Leakage Current (Common Port Only 1A, 2A)      | Common Port (1A, 2A), V <sub>IN</sub> =0V to 4.3V,<br>V <sub>CC</sub> =0V nB0,<br>nB1=Floating       | 0V                  |                       |      |      |                              | ±1   | μA   |
| R <sub>ON</sub>                                | Switch On Resistance <sup>(2,5)</sup>                    | I <sub>ON</sub> =100mA, nB0 or nB1=0.7V, 3.6V<br>Figure 3                                            | 4.30                |                       | 0.50 |      |                              | 1.00 | Ω    |
|                                                |                                                          | I <sub>ON</sub> =100mA, nB0 or nB1=0.7V, 2.3V<br>Figure 3                                            | 3.00                |                       | 0.80 |      |                              | 1.20 |      |
|                                                |                                                          | I <sub>ON</sub> =100mA, nB0 or nB1=0V, 0.7V, 1.6V, 2.3V<br>Figure 3                                  | 2.30                |                       | 1.10 |      |                              |      |      |
|                                                |                                                          | I <sub>ON</sub> =100mA, nB0 or nB1=0V, 0.7V, 1.65V<br>Figure 3                                       | 1.65                |                       | 1.50 |      |                              |      |      |
| ΔR <sub>ON</sub>                               | On Resistance Matching Between Channels <sup>(3,5)</sup> | I <sub>ON</sub> =100mA, nB0 or nB1=0.7V                                                              | 4.30                |                       | 0.08 |      |                              | 0.25 | Ω    |
|                                                |                                                          |                                                                                                      | 3.00                |                       | 0.20 |      |                              | 0.25 |      |
|                                                |                                                          |                                                                                                      | 2.30                |                       | 0.40 |      |                              |      |      |
|                                                |                                                          |                                                                                                      | 1.65                |                       | 0.50 |      |                              |      |      |
| 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                |                       |      |      |                              | 0.4  | Ω    |
|                                                |                                                          |                                                                                                      | 3.00                |                       |      |      |                              | 0.4  |      |
|                                                |                                                          |                                                                                                      | 2.30                |                       | 0.9  |      |                              |      |      |
|                                                |                                                          |                                                                                                      | 1.65                |                       | 1.2  |      |                              |      |      |
| 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>CCT</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:

- 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>ON max</sub> - R<sub>ON min</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 (R<sub>ON</sub>) over the specified range of conditions.
- Guaranteed by characterization, not production tested for V<sub>CC</sub>=1.65 – 3.0V.

## AC Electrical Characteristics

All typical value are for  $V_{CC}=3.3V$  at 25°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, $R_L=50\Omega$ , $C_L=35pF$            | 3.60 to 4.30 |                   |      | 55   |                            | 60   | ns   | Figure 6<br>Figure 7 |
|           |                                                  |                                                         | 2.70 to 3.60 |                   |      | 60   |                            | 65   |      |                      |
|           |                                                  |                                                         | 2.30 to 2.70 |                   |      | 65   |                            | 70   |      |                      |
|           |                                                  |                                                         | 1.65 to 1.95 |                   | 70   |      |                            |      |      |                      |
| $t_{OFF}$ | Turn-Off Time                                    | nB0 or nB1=1.5V, $R_L=50\Omega$ , $C_L=35pF$            | 3.60 to 4.30 |                   |      | 30   | 5                          | 35   | ns   |                      |
|           |                                                  |                                                         | 2.70 to 3.60 |                   |      | 35   | 5                          | 40   |      |                      |
|           |                                                  |                                                         | 2.30 to 2.70 |                   |      | 40   | 5                          | 45   |      |                      |
|           |                                                  |                                                         | 1.65 to 1.95 |                   | 40   |      |                            |      |      |                      |
| $t_{BBM}$ | Break-Before-Make Time <sup>(6)</sup>            | nB0 or nB1=1.5V, $R_L=50\Omega$ , $C_L=35pF$            | 3.60 to 4.30 |                   | 15   |      | 2                          |      | ns   | Figure 8             |
|           |                                                  |                                                         | 2.70 to 3.60 |                   | 15   |      | 2                          |      |      |                      |
|           |                                                  |                                                         | 2.30 to 2.70 |                   | 15   |      | 2                          |      |      |                      |
|           |                                                  |                                                         | 1.65 to 1.95 |                   | 16   |      | 2                          |      |      |                      |
| Q         | Charge Injection <sup>(6)</sup>                  | $C_L=1.0nF$ , $V_S=0V$ , $R_S=0\Omega$                  | 1.65 to 4.30 |                   | 25   |      |                            |      | pC   | Figure 12            |
| OIRR      | Off Isolation <sup>(6)</sup>                     | $f=100kHz$ , $R_L=50\Omega$ , $C_L=0pF$                 | 1.65 to 4.30 |                   | -80  |      |                            |      | dB   | Figure 10            |
| Xtalk     | Crosstalk <sup>(6)</sup>                         | $f=100kHz$ , $R_L=50\Omega$ , $C_L=0pF$                 | 1.65 to 4.30 |                   | -100 |      |                            |      | dB   | Figure 11            |
| BW        | -3db Bandwidth <sup>(6)</sup>                    | $R_L=50\Omega$ , $C_L=0pF$                              | 1.65 to 4.30 |                   | >50  |      |                            |      | MHz  | Figure 9             |
| THD+N     | Total Harmonic Distortion + Noise <sup>(6)</sup> | $f=20Hz$ to $20kHz$ , $R_L=32\Omega$ , $V_{IN}=2V_{pp}$ | 1.65 to 4.30 |                   | .06  |      |                            |      | %    | Figure 15            |

### Notes:

6. Guaranteed by characterization, not production tested

## Capacitance

All capacitance specifications are guaranteed by characterization and are not production tested.

| 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 13 |
| $C_{OFF}$ | B Port Off Capacitance        | $f=1MHz$   | 3.3          |                   | 30   |      | pF   | Figure 13 |
| $C_{ON}$  | A Port On Capacitance         | $f=1MHz$   | 3.3          |                   | 50   |      | pF   | Figure 14 |

## Test Diagrams

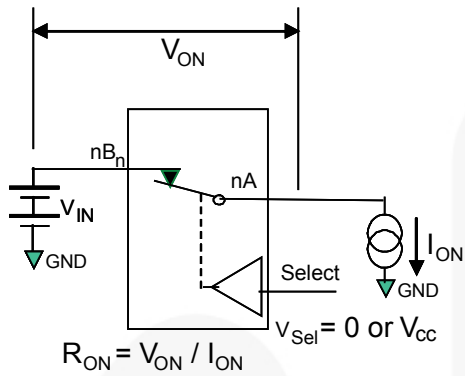
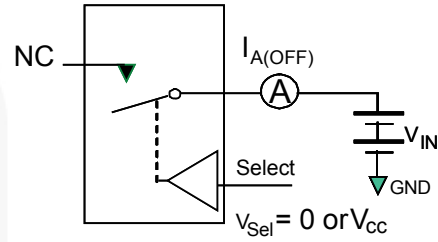


Figure 3. On Resistance



\*\*Each switch port is tested separately.

Figure 4. Off Leakage (Ports Tested Separately)

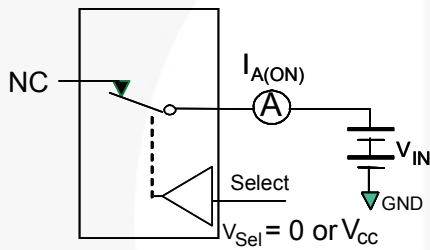


Figure 5. On Leakage

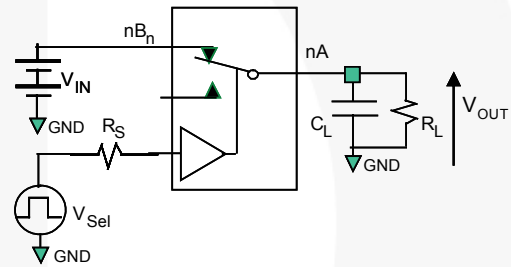


Figure 6. Test Circuit Load

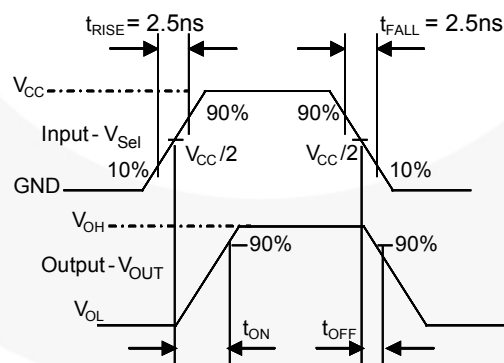


Figure 7. Turn-On / Turn-Off Waveforms

## Test Diagrams (Continued)

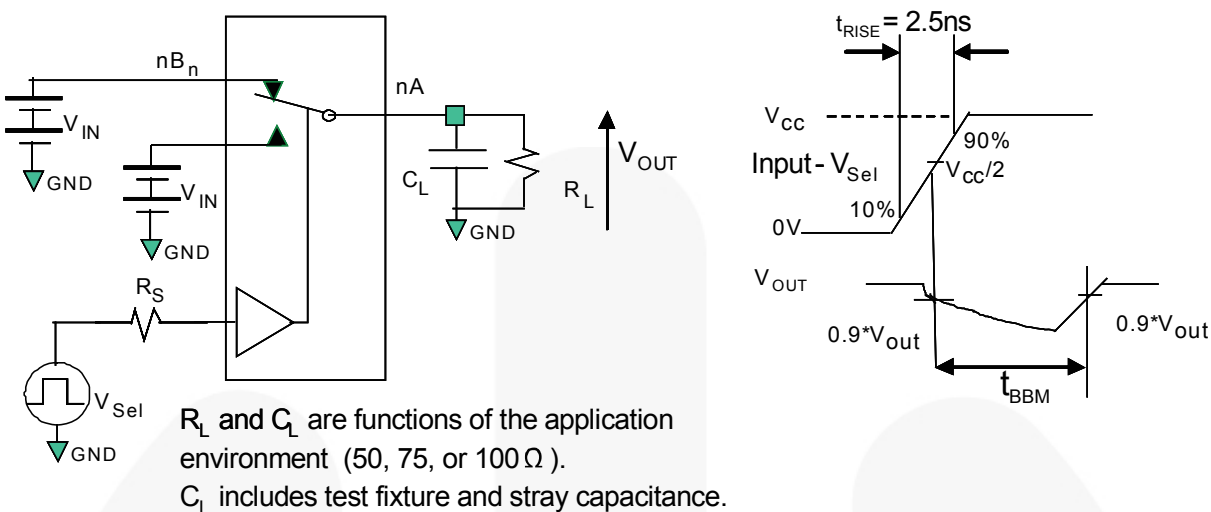


Figure 8. Break-Before-Make Interval Timing

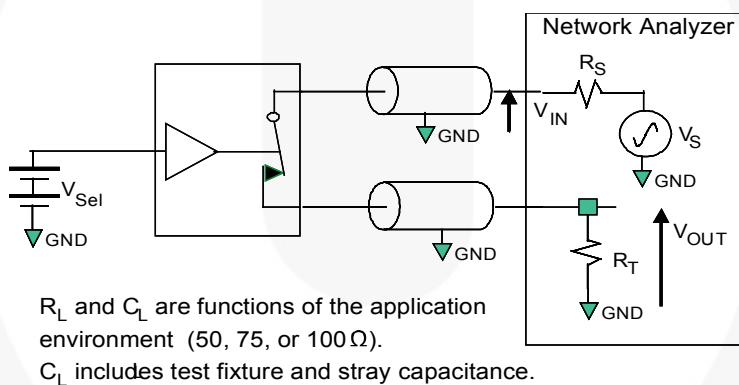


Figure 9. Bandwidth

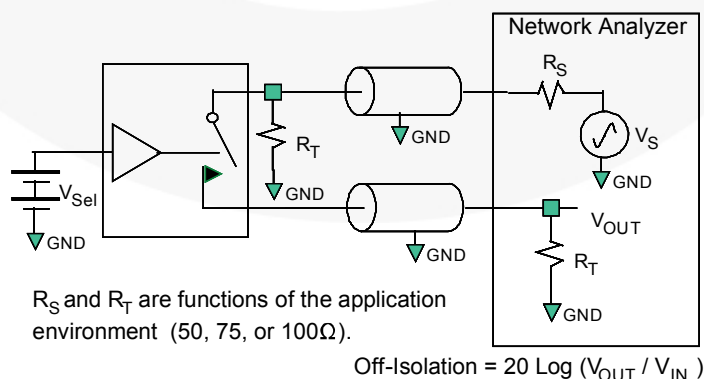
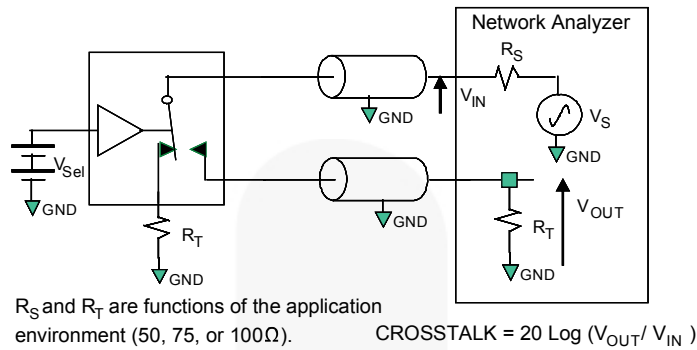
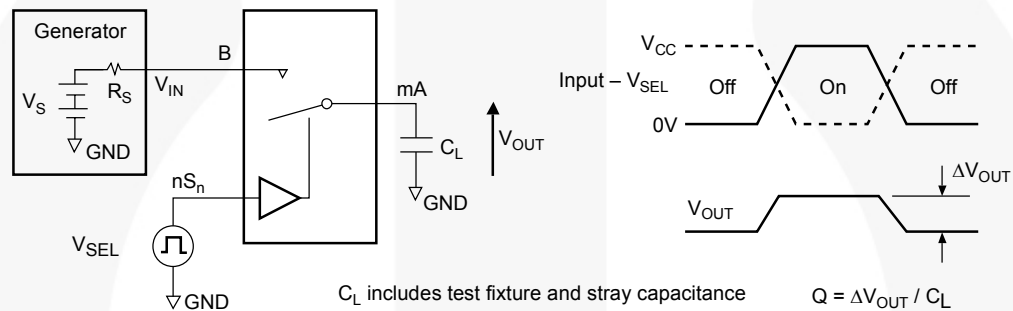


Figure 10. Channel Off Isolation

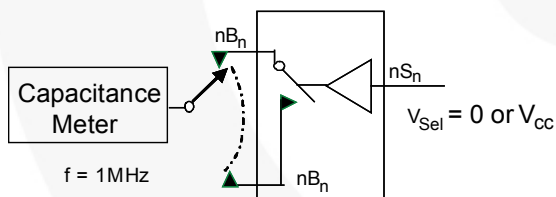
# Test Diagrams (Continued)



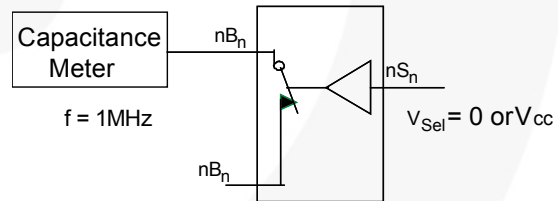
**Figure 11. Adjacent Channel Crosstalk**



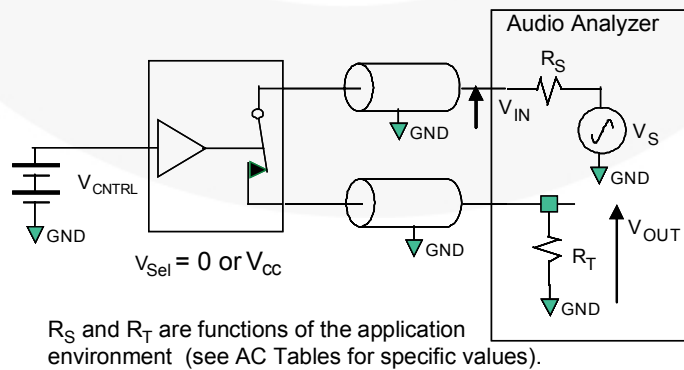
**Figure 12. Charge Injection Test**



**Figure 13. Channel Off Capacitance**



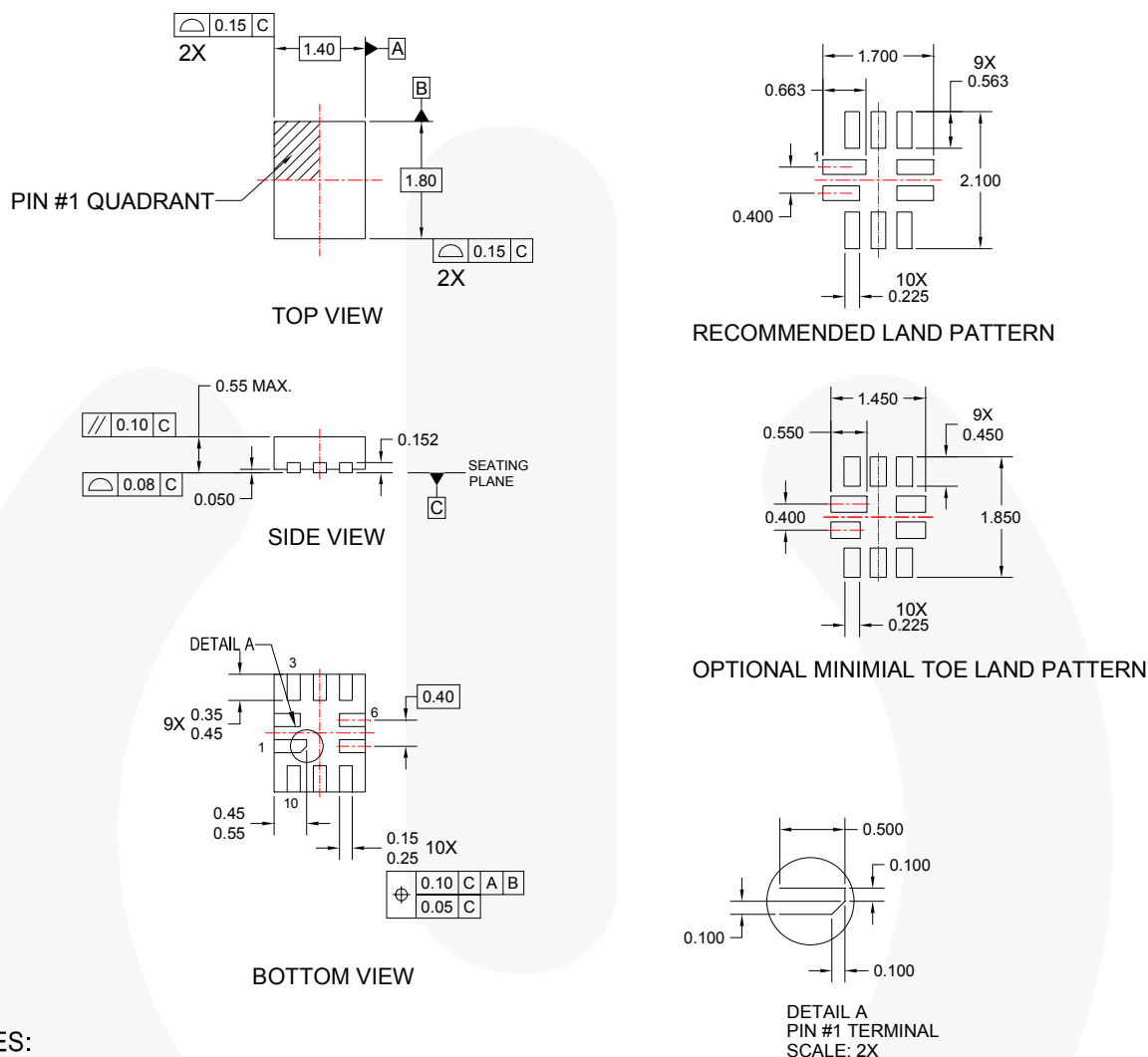
**Figure 14. Channel On Capacitance**



**Figure 15. Total Harmonic Distortion**



## Physical Dimensions



### NOTES:

- DIMENSIONS ARE IN MILLIMETERS.
- DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994
- DRAWING FILENAME: UMLP10Arev2

**Figure 16. 10-Lead Quad Ultrathin Molded Leadless Package (UMLP)**

Click here for tape and reel specifications, available at:  
[http://www.fairchildsemi.com/products/analog/pdf/UMLP10\\_TNR.pdf](http://www.fairchildsemi.com/products/analog/pdf/UMLP10_TNR.pdf)

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|--------------------------|--------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| AccuPower™               | F-PFST™                                                                                    | PowerTrench®                                                                                                            | The Power Franchise®                                                                        |
| Auto-SPM™                | FRFET®                                                                                     | PowerXS™                                                                                                                | The Right Technology for Your Success™                                                      |
| Build it Now™            | Global Power Resource™                                                                     | Programmable Active Droop™                                                                                              | <b>the power franchise</b>                                                                  |
| CorePLUS™                | Green FPS™                                                                                 | QFET®                                                                                                                   | TinyBoost™                                                                                  |
| CorePOWER™               | Green FPST™ e-Series™                                                                      | QST™                                                                                                                    | TinyBuck™                                                                                   |
| CROSSQLT™                | Gmax™                                                                                      | Quiet Series™                                                                                                           | TinyCalc™                                                                                   |
| CTL™                     | GTO™                                                                                       | RapidConfigure™                                                                                                         | TinyLogic®                                                                                  |
| Current Transfer Logic™  | IntelliMAX™                                                                                |  Saving our world, 1mW/W/kW at a time™ | TINYOPTO™                                                                                   |
| DEUXPEED®                | ISOPLANAR™                                                                                 | SignalVise™                                                                                                             | TinyPower™                                                                                  |
| Dual Cool™               | MegaBuck™                                                                                  | SmartMax™                                                                                                               | TinyPWM™                                                                                    |
| EcoSPARK®                | MICROCOUPLER™                                                                              | SMART START™                                                                                                            | TinyWire™                                                                                   |
| EfficientMax™            | MicroFET™                                                                                  | SPM®                                                                                                                    | TriFault Detect™                                                                            |
| ESBC™                    | MicroPak™                                                                                  | STEALTH™                                                                                                                | TRUECURRENT™*                                                                               |
| <b>F</b> ®               | MicroPak2™                                                                                 | SuperFET™                                                                                                               | μSerDes™                                                                                    |
| Fairchild®               | MillerDrive™                                                                               | SuperSOT™-3                                                                                                             |  SerDes® |
| Fairchild Semiconductor® | MotionMax™                                                                                 | SuperSOT™-6                                                                                                             | UHC®                                                                                        |
| FACT Quiet Series™       | Motion-SPM™                                                                                | SuperSOT™-8                                                                                                             | Ultra FRFET™                                                                                |
| FACT®                    | OptoHIT™                                                                                   | SupreMOS®                                                                                                               | UniFET™                                                                                     |
| FAST®                    | OPTOLOGIC®                                                                                 | SyncFET™                                                                                                                | VCX™                                                                                        |
| FastvCore™               | OPTOPLANAR®                                                                                | Sync-Lock™                                                                                                              | VisualMax™                                                                                  |
| FETBench™                |  PDP SPM™ |  SYSTEM GENERAL®                       | XS™                                                                                         |
| FlashWriter®             | Power-SPM™                                                                                 |                                                                                                                         |                                                                                             |
| FPST™                    |                                                                                            |                                                                                                                         |                                                                                             |

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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, [www.fairchildsemi.com](http://www.fairchildsemi.com), under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage, and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status        | Definition                                                                                                                                                                                          |
|--------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advance Information      | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.                                                                       |
| Preliminary              | First Production      | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production       | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.                                               |
| Obsolete                 | Not In Production     | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.                                                    |

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