

# FSA2147 — Low-Voltage, DPST Analog Switch with Negative Signal Capability and Built-in Termination to Eliminate Pop

## Features

- Built-In Termination on Unselected Audio Paths Inhibits Audio Pop
- 6pF Typical Switch Off Capacitance
- 2.5Ω Typical On Resistance
- Negative-Swing-Capable
- Power-Off Protection
- Flow-Through Pin Out Eliminates PCB Vias

## Description

The FSA2147 is a Double-Pole, Single Throw (DPST) switch. The audio path defaults to audio mute and is enabled with /OE. The FSA2147 includes a power-off feature on the common port when  $V_{CC}=0V$  to guarantee signal isolation.

## IMPORTANT NOTE:

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

## Applications

- MP3 Player, Cell Phone, PDA, Digital Camera, and Notebook Computers

## Ordering Information

| Part Number | Top Mark | Operating Temperature Range | Eco Status | Package Description  | Packing Method           |
|-------------|----------|-----------------------------|------------|--|--------------------------|
| FSA2147K8X  | 2147     | -40°C to +85°C              | RoHS       | 8-Lead US8, JEDEC MO-187, Variation CA, 3.0mm Wide Package | 3000 Units Tape and Reel |

For Fairchild's definition of Eco Status, please visit: [http://www.fairchildsemi.com/company/green/rohs\\_green.html](http://www.fairchildsemi.com/company/green/rohs_green.html).

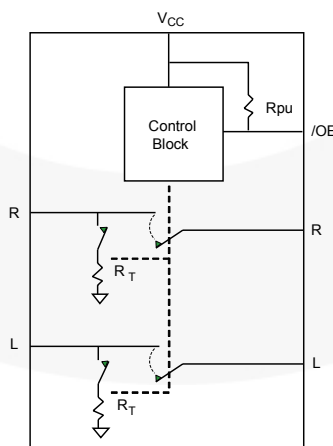


Figure 1. Analog Symbol

## Pin Configuration

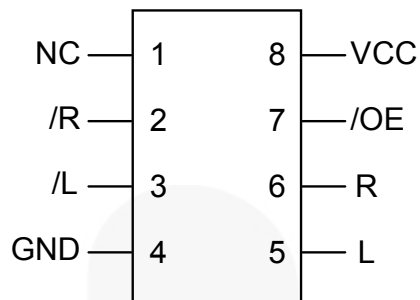


Figure 2. 8-Pin US8

## Pin Descriptions

| Pin # | Name            | Description  |
|-------|-----------------|--|
| 8     | V <sub>CC</sub> | Power supply.  |
| 7     | /OE             | Output enable. This pin defaults HIGH, allowing the user to mute the audio channel during power up. The audio path is only connected when /OE is driven LOW. |
| 6, 5  | R, L            | Audio right and left input sources.  |
| 2, 3  | /R, /L          | Audio common connector port.   |

## Truth Table

| V <sub>CC</sub> | /OE  | Switch |
|-----------------|------|--------|
| LOW             |      | OPEN   |
| HIGH            | LOW  | ON     |
| HIGH            | HIGH | OPEN   |

## 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            | 4.6  | V     |
| /OE          | Output Enable Control Signal                                  | -0.5            | 4.6  | V     |
| $V_{SW}$     | Switch I/O Voltage <sup>(1)</sup>                             | $V_{CC}-4.6$    | 4.6  | V     |
| $I_{IK}$     | Input Clamp Diode Current                                     |                 | -50  | mA    |
| $I_{SW}$     | Switch I/O Current (Continuous)                               |                 | 100  | mA    |
| $I_{SWPEAK}$ | Peak Switch Current (Pulsed at 1ms Duration, <10% Duty Cycle) |                 | 150  | 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      | 12   | kV    |
|              |   | All Other Pins  | 2    |       |
|              |   | $V_{CC}$ to GND | 12   |       |
|              | Charged Discharge Model, JEDEC: JESD22-C101                   |                 | 2    |       |

**Note:**

1. The input and output negative ratings may be exceeded if the 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               | 2.7          | 4.3  | V     |
| /OE      | Output Enable Control Signal | 3.0          | 4.3  | V     |
| $V_{SW}$ | Switch I/O Voltage           | $V_{CC}-4.3$ | 4.3  | V     |
| $T_A$    | Operating Temperature        | -40          | +85  | °C    |

## DC Electrical Characteristics

All typical values are at 25°C unless otherwise specified.

| Symbol                   | Parameter   | V <sub>CC</sub> (V) | Conditions   | T <sub>A</sub> = -40 to +85°C |                     |                 | Unit |
|--------------------------|---|---------------------|--|-------------------------------|---------------------|-----------------|------|
|                          |   |                     |  | Min.                          | Typ. <sup>(5)</sup> | Max.            |      |
| Common Pins              |   |                     |  |                               |                     |                 |      |
| V <sub>IK</sub>          | Clamp Diode Voltage                                 | 3.0                 | I <sub>IK</sub> = -18mA                                      |                               |                     | -1.2            | V    |
| V <sub>IH</sub>          | Control Input Voltage HIGH                          | 2.7 to 4.3          |  | 1.7                           |                     |                 |      |
| V <sub>IL</sub>          | Control Input Voltage LOW                           | 2.7 to 4.3          |  |                               |                     | 0.6             |      |
| I <sub>IN</sub>          | /OE Input Leakage Current                           | 4.3                 | V <sub>IN</sub> = 4.3V                                       | 1                             |                     | -1              | μA   |
| I <sub>OFF</sub>         | Power Off Leakage Current (Common Port Only /R, /L) | 0                   | Common Port (/R, /L)<br>V <sub>SW</sub> = 4.3V or Floating   | -10                           |                     | 10              | μA   |
| I <sub>NC(ON)</sub>      | On-Leakage Current of Port /R or /L                 | 4.3                 | /R, /L = 0.3V, 4.0V<br>R, L = Floating<br>Figure 8           | -250                          | 1                   | 250             | nA   |
| R <sub>PU</sub>          | /OE Internal Pull-Up Resistor                       | 4.3                 |  |                               | 3                   |                 | MΩ   |
| R <sub>T</sub>           | Audio Path Termination Resistors                    | 4.3                 | V <sub>IN</sub> =0.3V or 4.0V                                |                               | 100                 |                 | Ω    |
| V <sub>Audio</sub>       | Analog Signal Range                                 | 2.7 to 4.3          |  | V <sub>CC</sub> -4.3V         |                     | V <sub>CC</sub> | V    |
| R <sub>ONAudio</sub>     | Switch On Resistance <sup>(2)</sup>                 | 2.7                 | V <sub>L/R</sub> = -1.5V, 0V, 1.5V<br>I <sub>ON</sub> = 60ma |                               | 1.5                 | 3.0             | Ω    |
| ΔR <sub>ONAudio</sub>    | Delta R <sub>ON</sub> <sup>(3)</sup>                | 2.7                 | V <sub>L/R</sub> = 0.7V I <sub>ON</sub> = 60mA               |                               | 0.4                 |                 | Ω    |
| R <sub>FLAT(Audio)</sub> | R <sub>ON</sub> Flatness <sup>(4)</sup>             | 2.7                 | V <sub>SW</sub> =-1.5V to 1.5V,<br>I <sub>ON</sub> = 60mA    |                               | 0.4                 | 0.8             | Ω    |
| Power Supply             |   |                     |  |                               |                     |                 |      |
| I <sub>CC</sub>          | Quiescent Supply Current                            | 4.3                 | /OE = Low or V <sub>CC</sub> , I <sub>OUT</sub> = 0          |                               | 1.5                 | 15              | μA   |

### Notes:

- On resistance is determined by the voltage drop between the A and B pins at the indicated current through the switch.
- Δ R<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 values of on resistance over the specified range of conditions.
- Guaranteed by characterization; not production tested.

## AC Electrical Characteristics

All typical value are for  $V_{CC} = 3.6V$  at  $25^{\circ}C$  unless otherwise specified.

| Symbol    | Parameter                                   | $V_{CC}$ (V) | Conditions   | $T_A = -40$ to $+85^{\circ}C$ |                     |      | Unit    |
|-----------|---|--------------|--|-------------------------------|---------------------|------|---------|
|           |   |              |  | Min.                          | Typ. <sup>(6)</sup> | Max. |         |
| $t_{ON}$  | Turn-On Time, /OE to Output                 | 2.7 to 4.3   | $V_{R/L} = 1.0V$<br>$R_L = 50\Omega$ , $C_L = 50pF$<br>Figure 9, Figure 10,<br>Figure 11 |                               | 2                   |      | $\mu s$ |
| $t_{OFF}$ | Turn-Off Time, /OE to Output                | 2.7 to 4.3   | $V_{R/L} = 1.0V$<br>$R_L = 50\Omega$ , $C_L = 50pF$<br>Figure 9, Figure 10,<br>Figure 11 |                               | 2                   |      | $\mu s$ |
| Xtalk     | Non-Adjacent Channel Crosstalk (Audio Mode) | 3.3 to 4.3   | $f = 20kHz$ , $R_T = 32\Omega$ ,<br>$C_L = 0pF$<br>Figure 16                             |                               | -75                 |      | dB      |
| THD       | Total Harmonic Distortion (Audio Mode)      | 3.0 to 4.3   | $f = 20Hz$ to $20kHz$<br>$R_L = 32\Omega$ , $V_{IN} = 2V_{pp}$<br>Figure 14              |                               | 0.05                |      | %       |
| SNR       | Signal-to-Noise Ratio (Audio Mode)          | 3.3 to 4.3   | $f = 20kHz$ to $20kHz$ ,<br>$R_L = 32\Omega$ , $V_{IN} = 2V_{pp}$<br>Figure 14           |                               | 80                  |      | dB      |

**Note:**

6. Guaranteed by characterization; not production tested.

## Capacitance

All typical values are at  $25^{\circ}C$  unless otherwise specified.

| Symbol   | Parameter                     | $V_{CC}$ (V) | Conditions        | $T_A = -40$ to $+85^{\circ}C$ |                     |      | Unit |
|----------|-------------------------------|--------------|-------------------|-------------------------------|---------------------|------|------|
|          |                               |              |                   | Min.                          | Typ. <sup>(7)</sup> | Max. |      |
| $C_{IN}$ | Control Pin Input Capacitance | 3.0 to 4.3   | $V_{BIAS} = 0.2V$ |                               | 2.5                 |      | pF   |

**Note:**

7. Guaranteed by characterization; not production tested.

## Typical Characteristics

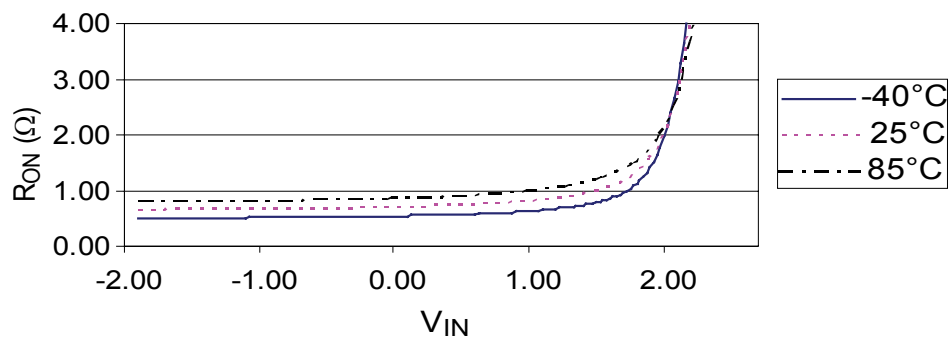


Figure 3.  $R_{ON}$ ,  $V_{CC} = 2.7V$

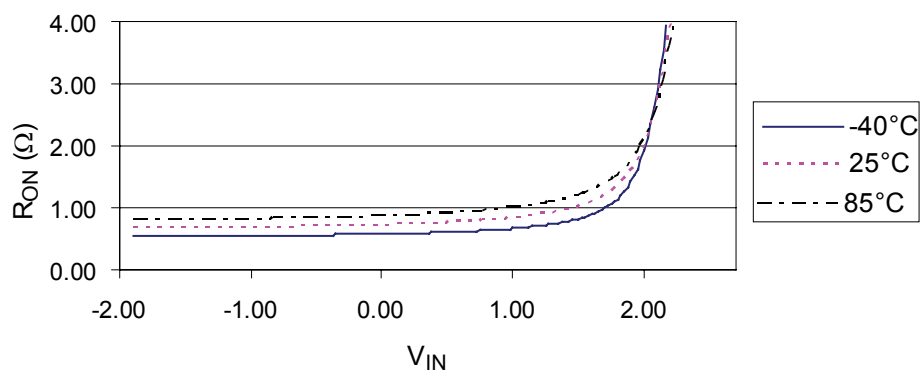


Figure 4.  $R_{ON}$ ,  $V_{CC} = 2.7V$

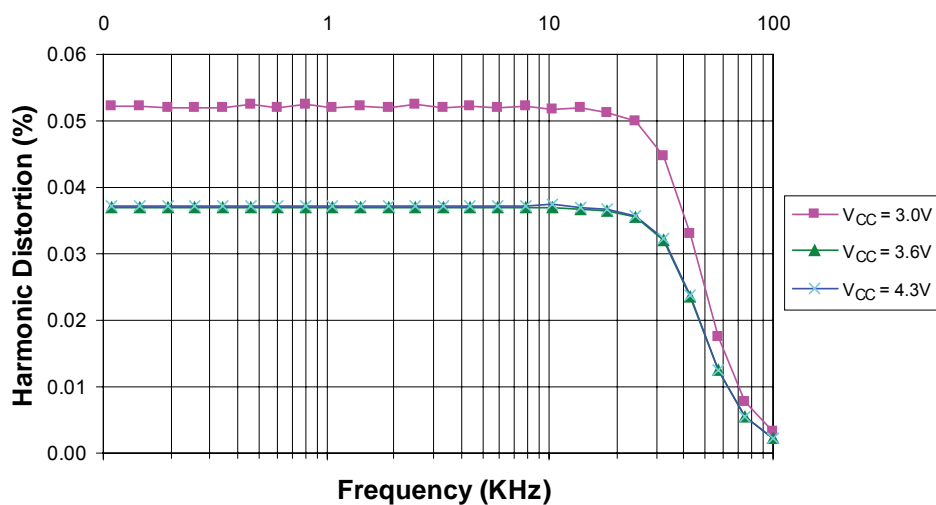


Figure 5. Total Harmonic Distortion

## Test Diagrams

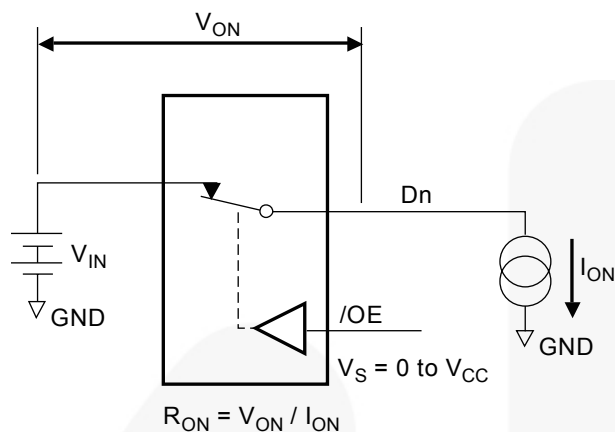
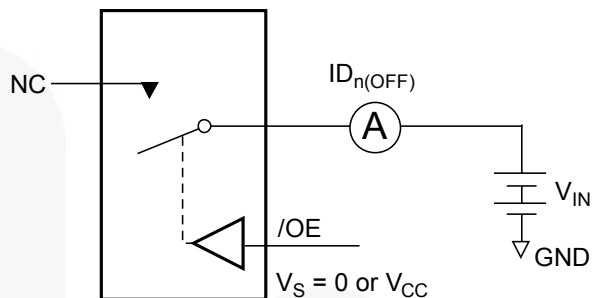


Figure 6. On Resistance



Each switch port is tested separately.

Figure 7. Off Leakage

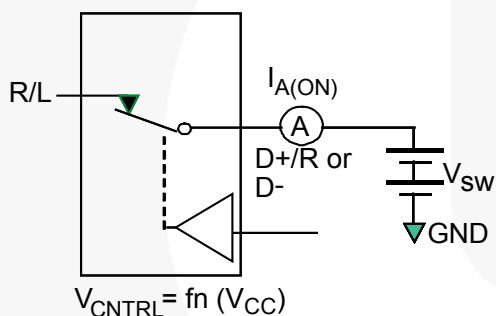
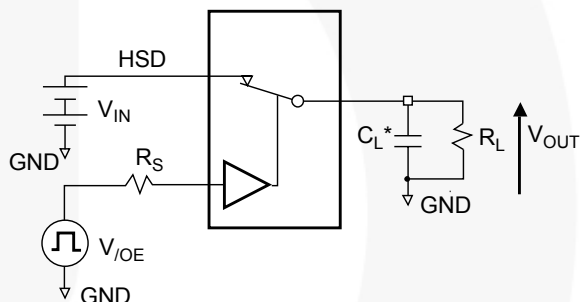


Figure 8. On Leakage



$R_L$ ,  $R_S$ , and  $C_L$  are functions of the application environment (see tables for specific values).

\* $C_L$  includes test fixture and stray capacitance.

Figure 9. AC Test Circuit Load

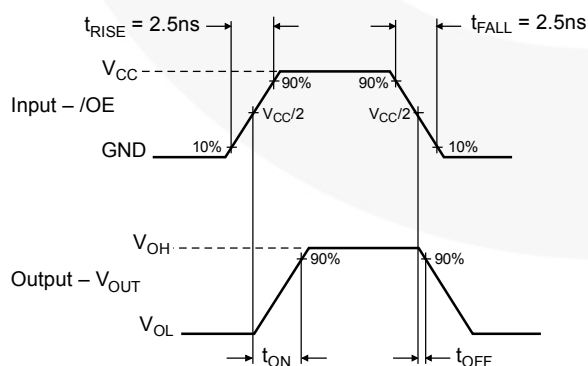


Figure 10. Turn-On / Turn-Off Waveforms

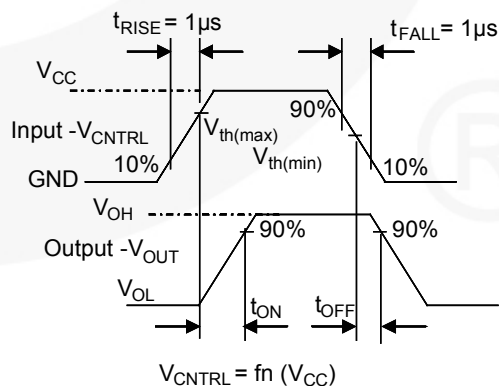


Figure 11. Turn-On / Turn-Off Waveforms

## Test Diagrams (Continued)

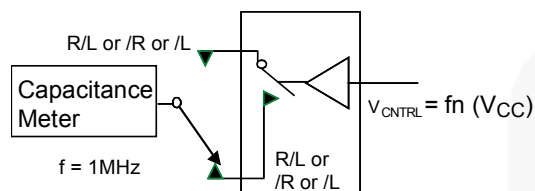


Figure 12. Channel Off Capacitance

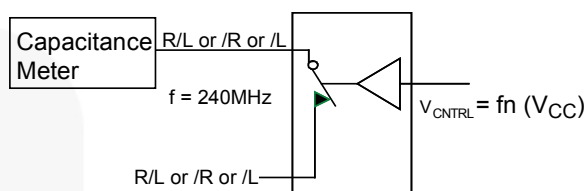


Figure 13. Channel On Capacitance

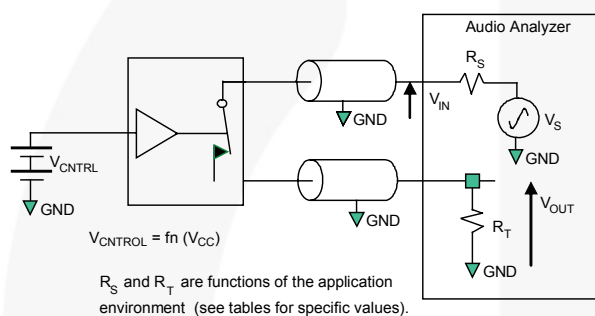


Figure 14. Total Harmonic Distortion

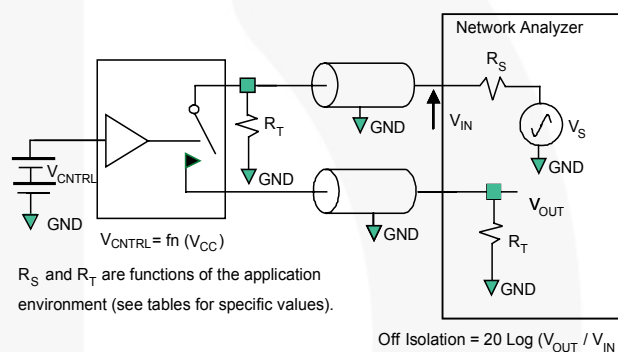


Figure 15. Channel Off Isolation

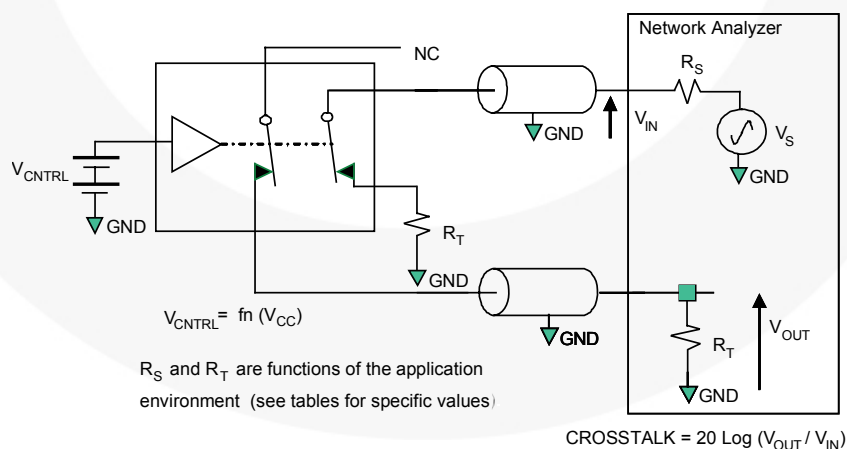


Figure 16. Non-Adjacent Channel-to-Channel Crosstalk






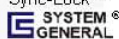


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