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November 2014

# FSA551
# Dual SPST Depletion Mode Audio Switch

## Features

- Dual SPST
- Depletion Mode Technology
- -3 dB Bandwidth: 240 MHz
- $V_{CC-OFF}$: 1.5 V to 3.0 V
- $V_{CC-ON}$: 0 V to 0.2 V
- $V_{SW-OFF}$: -0.3 V to 3 V
- $V_{SW-ON}$: -0.3 V to 3 V
- $R_{ON}$: 0.38 Ω Typical
- $R_{ON}$ Flat: 0.01 Ω (Typical)
- THD+N: 0.0005% (Typical)
- Fairchild Green, RoHS Compliant, Halogen Free

## Description

The FSA551 is a high-performance dual single-pole single-throw (SPST x 2) audio switch. The Depletion Mode technology allows the device to conduct signals when there is no $V_{CC}$ available and to isolate signals when $V_{CC}$ is present. During signal conduction, the Depletion Mode gate control allows the FSA551 to achieve excellent THD+N performance while consuming minimal power.

## Related Resources

- FSA551 Evaluation Board

## Applications

- Smart Phones
- Tablets, Ultra Books

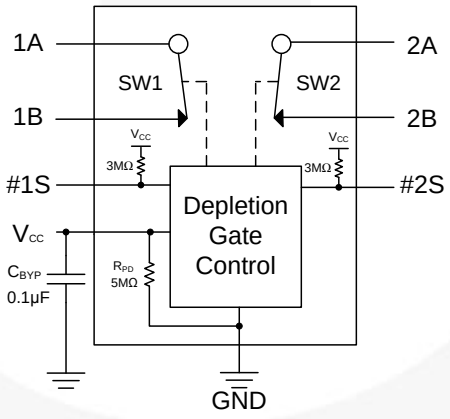



**Figure 1. Top Level Block Diagram**

## Ordering Information

| Part Number | Operating Temperature Range | Top Mark | Package | Packing Method |
|---|---|---|---|---|
| FSA551UCX | -40 to 85°C | U9 | 9-Ball WLCSP, 0.40 mm Pitch, 1.215 x 1.385 x 0.58 mm (Nominal) | 3000 Units on Tape & Reel |

## Pin Configuration

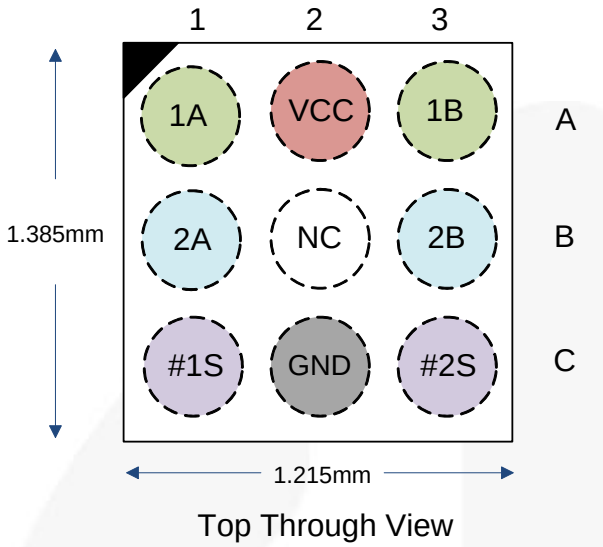



**Figure 2. Top Through View**

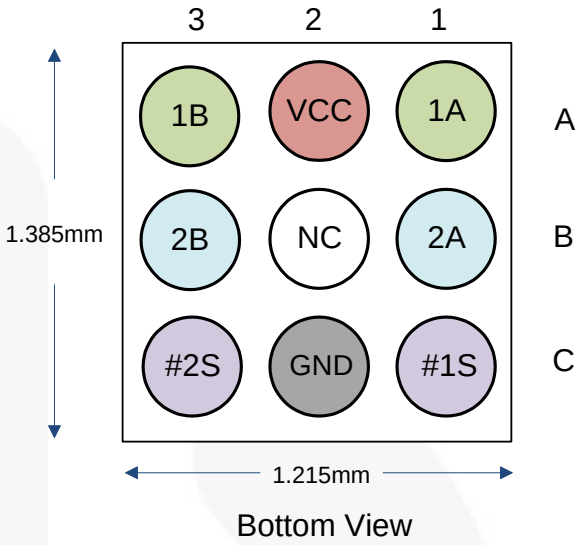



**Figure 3. Bottom View**

## Pin Descriptions

| Pin # | Name | Type | Description |
|---|---|---|---|
| A1 | 1A | Depletion I/O | A-Port of Switch 1 (Normally Closed) |
| A3 | 1B | Depletion I/O | B-Port of Switch 1 (Normally Closed) |
| C1 | #1S | Control | Select to Enable/Disable SW1 (Enable LOW) |
| A2 | $V_{CC}$ | Power Supply | Power Supply Input |
| B2 | NC | No Connect | Do Not Connect |
| C2 | GND | Ground | Ground |
| B1 | 2A | Depletion I/O | A-Port of Switch 2 (Normally Closed) |
| B3 | 2B | Depletion I/O | B-Port of Switch 2 (Normally Closed) |
| C3 | #2S | Control | Select to Enable/Disable SW2 (Enable LOW) |

**Table 1. Depletion Mode Control Truth Table**

| $V_{CC}$ | #1S | #2S | Switch 1 | Switch 2 |
|---|---|---|---|---|
| LOW | X | X | ON | ON |
| HIGH | HIGH | HIGH | OFF | OFF |
| HIGH | LOW | HIGH | ON | OFF |
| HIGH | HIGH | LOW | OFF | ON |

**Table 2. Recommended External Component**

| Component | Description | Vendor | Parameter | Min. | Typ. | Unit |
|---|---|---|---|---|---|---|
| $C_{BYP}$ | 0.1 µF, 10%, 6.3 V, X5R, 0201 | Murata GRM033R60J104K | C | 0.65 | 0.1 | µF |

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol | Parameter | | Min. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply/Control Voltage | | -0.5 | 4.6 | V |
| $V_{CNTRL}$ | Control Input Voltage | #1S, #2S | -0.5 | 4.6 | V |
| $V_{SW(ON)}$ | DC Switch I/O Voltage (Switch Conducting) | 1A, 1B, 2A, 2B | -0.5 | 3.3 | V |
| $V_{SW(OFF)}$ | DC Switch I/O Voltage (Switch Isolated) | 1A, 1B, 2A, 2B | -0.5 | 3.3 | V |
| $I_{SW}$ | Switch I/O Current | $V_{CC}$=0 V (Switch Conducting) | | 350 | mA |
| $I_{SWPEAK}$ | Peak Switch Current | Pulsed at 1 ms Duration, <10% Duty Cycle | | 500 | mA |
| ESD | Human Body Model, ANSI/ESDA/JEDEC JS-001-2012 | I/O Ports | | 7 | kV |
| | | All Other Pins | | 5 | |
| | Charged Device Model, JEDEC: JESD22-C101 | | | 2 | |
| | IEC 61000-4-2 System | Contact | | 8 | |
| | | Air Gap | | 15 | |
| $T_A$ | Absolute Maximum Operating Temperature | | -40 | +85 | °C |
| $\Theta_{JA}$ | Thermal Resistance, Junction-to-Ambient | 2S2P JEDEC std. PCB | | 97 | °C/W |
| $T_{STG}$ | Storage Temperature | | -65 | +150 | °C |

## 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 these ratings or designing to Absolute Maximum Ratings.

| Symbol | Parameter | | Min. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{CC(ON)}$ | Supply Voltage with Depletion Switch Conducting (1A=1B; 2A=2B) | | 0 | 0.2 | V |
| $V_{CC(OFF)}$ | Supply Voltage with Depletion Switch Isolated (1A≠1B; 2A≠2B; #1S=#2S=HIGH) | | 1.5 | 3.0 | V |
| $V_{SW(ON)}$ | DC Switch I/O Voltage | Switch Conducting | -0.3 | 3.0 | V |
| $V_{SW(OFF)}$ | DC Switch I/O Voltage | Switch Isolated | -0.3 | 3.0 | V |
| $V_{CNTRL}$ | Control Input Voltage | #1S, #2S | 0 | 3.0 | V |

## DC Electrical Characteristics

Unless otherwise specified, typical values are for $T_A$=25ºC.

| Symbol | Parameter | Condition | $V_{CC}$ (V) | $T_A$=-40°C to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| $V_{CC(HYS)}$ | Supply Voltage Hysteresis | | | | 450 | | mV |
| $I_{ON}$ | Switch-to-GND Leakage Current (Switch Conducting) | 1A=2.6 V, 1B=Float, 2A=2.6 V, 2B=Float | 0 | | 0.1 | 5 | µA |
| $I_{OFF}$ | Switch-to-GND Leakage Current (Switch Isolated) | 1A =2.6 V, 1B=GND, 2A=2.6 V, 2B=GND, #1S=#2S=$V_{CC}$ | 1.8 | | 0.1 | 10 | µA |
| $I_{CCT}$ | Increase in $I_{CC}$ per Control Voltage | #1S or #2S=1.2 V | 3.0 | | 7 | 15 | µA |
| $R_{ON}$ | Switch On Resistance | $I_{SW}$=100 mA, $V_{SW}$=-0.3 V to 3 V | 0 | | 0.38 | 0.60 | Ω |
| $\Delta R_{ON}$ | Switch On Resistance Difference, Channel to Channel | $I_{SW}$=100 mA, $V_{SW}$=-0.3 V to 3 V | 0 | | 0.01 | | Ω |
| $R_{FLAT(ON)}$ | On Resistance Flatness | $I_{SW}$=100 mA, $V_{SW}$=-0.3 V to 3 V | 0 | | 0.01 | | Ω |
| $R_{PD}$ | $V_{CC}$ Pull-Down Resistance | | <0.2 | | 5.0 | | MΩ |
| $R_{PU}$ | Control Pull-Up Resistance | | <0.2 | | 3.0 | | MΩ |
| $I_{CC}$ | Quiescent Supply Current | Switch Isolated, #1S=#2S=$V_{CC}$ | 1.5 - 3.0 | | 70 | 120 | µA |
| | | Switch On | 0.2 | | 0.1 | 0.5 | |
| $V_{IH}$ | Select Pin Input High Voltage | | 1.5 – 3.0 | 1.2 | | | V |
| $V_{IL}$ | Select Pin Input Low Voltage | | 1.5 – 3.0 | | | 0.55 | V |

## AC Electrical Characteristics

Unless otherwise specified, typical values are for $T_A$=25°C.

| Symbol | Parameter | Condition | $V_{CC}$ (V) | $T_A$=- 40°C to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| $t_{ON}$ | Turn-On Time $V_{CC}$ to Output | $R_L$=2 kΩ, $C_L$=10 pF, $V_{SW}$=3 V, (Measured 90/10%), Figure 5 | 1.8 → 0 | | 445 | | µs |
| $t_{OFF}$ | Turn-Off Time $V_{CC}$ to Output | $R_L$=2 kΩ, $C_L$=10 pF, $V_{SW}$=3 V, (Measured 90/10%), Figure 5 | 0 → 1.8 | | 175 | | µs |
| $t_{ONS}$ | Turn-On Time Control Pin | $_n$A=2 kΩ to 2.85 V, $_n$B=1 Ω//10 pF to GND, #$_n$S= 1.8 → 0 V, (Measured 20/80%), Figure 5 | 1.8 | | 205 | | µs |
| $t_{OFFS}$ | Turn-Off Time Control Pin | $_n$A=2 kΩ to 2.85 V, $_n$B=1 Ω//10 pF to GND, #$_n$S= 0 → 1.8 V, (Measured 20/80%), Figure 4, Figure 5 | 1.8 | | 29 | | µs |
| $O_{IRRA}$ | Port A Off Isolation | $_n$A=2 kΩ to GND, $_n$B=1 Ω to GND, #$_n$S=$V_{CC}$, Port B $V_{SW}$=600 $mV_{PP}$ Ground Referenced, (Measure at f=20 kHz), Figure 7 | 1.8 | | -75 | | dB |
| $O_{IRRB}$ | Port B Off Isolation | $_n$A=2 kΩ to 2.85 V, $_n$B=1 Ω to GND, #$_n$S=$V_{CC}$, Port A $V_{DC}$ + 300 $mV_{PP(AC)}$, (Measure at f=20 kHz), Figure 6 | 1.8 | | -100 | | dB |
| BW | -3dB Bandwidth | $R_L$=2 kΩ, $C_L$=0 pF | 0 | | 240 | | MHz |
| THD+N | Total Harmonic Distortion + Noise | $R_L$=2 kΩ, f=20 Hz to 20 kHz, DC Bias=0 V, $V_{SW}$=600 $mV_{PP}$, Measurement BW < 22 kHz | 0 | | 0.0005 | | % |

## Capacitance

| Symbol | Parameter | Condition | $V_{CC}$ (V) | $T_A$= +25°C | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| $C_{ON}$ | On Capacitance | f=1 MHz, 400 $mV_{PP}$, 1A, 1B, 2A, 2B | 0 | | 21 | | pF |
| $C_{OFF}$ | Off Capacitance | f=1 MHz, 400 $mV_{PP}$, 1A, 1B, 2A, 2B, #1S=#2S=$V_{CC}$ | 1.8 | | 25 | | pF |
| $C_{CTRL}$ | Control Pin Capacitance | f=1 MHz, 400 $mV_{PP}$, #1S, #2S | 1.8 | | 2.5 | | pF |

## Oscillator Frequency

| Symbol | Parameter | Condition | $V_{CC}$ (V) | $T_A$= +25°C | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| $f_{OSC}$ | Oscillator Frequency(1) | Oscillator Enabled | 1.8 | | 775 | | kHz |
| $f_{OSC\%}$ | Oscillator Frequency Tolerance Over Process & Temperature(1) | Oscillator Enabled | 1.8 | | | 30 | % |

**Note:**

1. Parameters guaranteed by Design and Characterization.

## Timing Diagrams

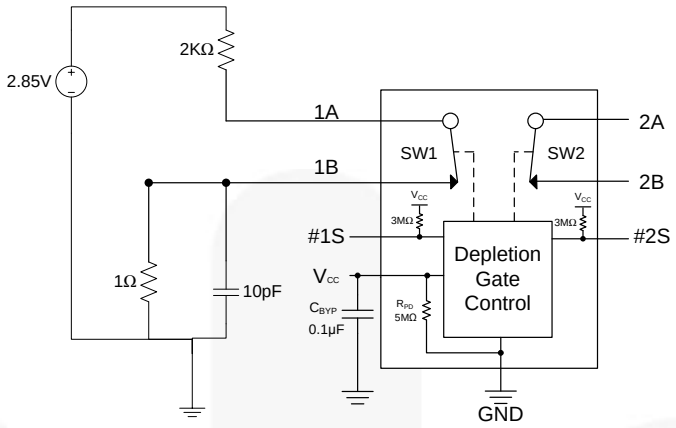



**Figure 4. $t_{ON}/t_{OFF}$, $t_{ONS}/t_{OFF}$**

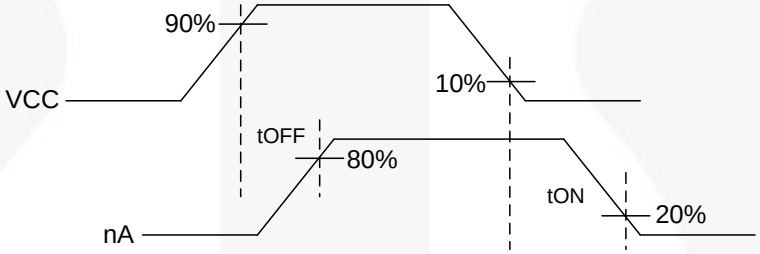



**Figure 5. Turn-On / Turn-Off Timing**

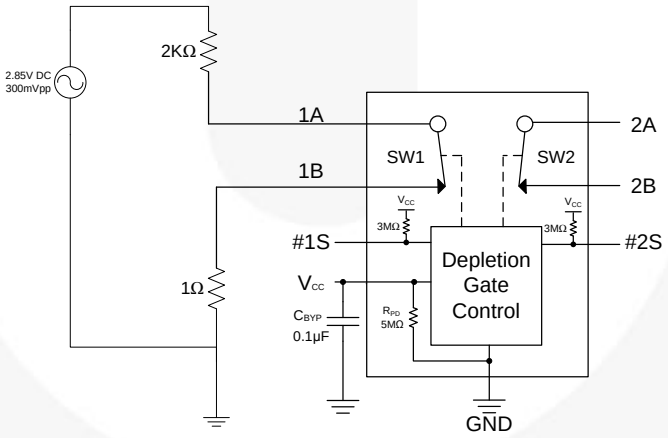



**Figure 6. Off Isolation (B Port)**

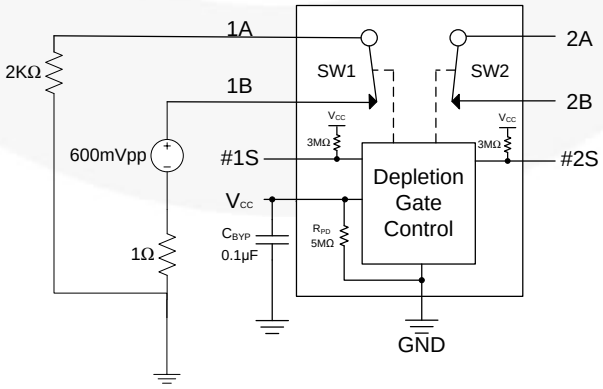
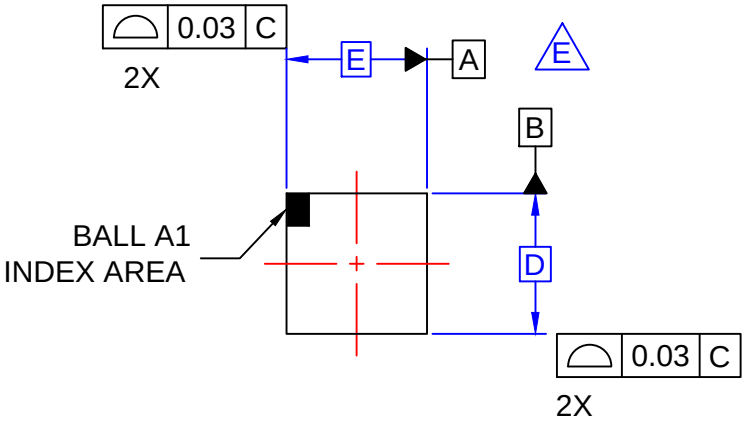


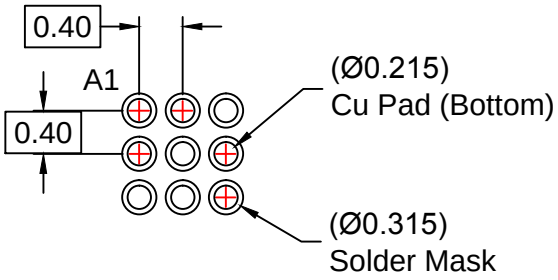

**Figure 7. Off Isolation (A Port) / Cross Talk**

## Product-Specific Dimensions

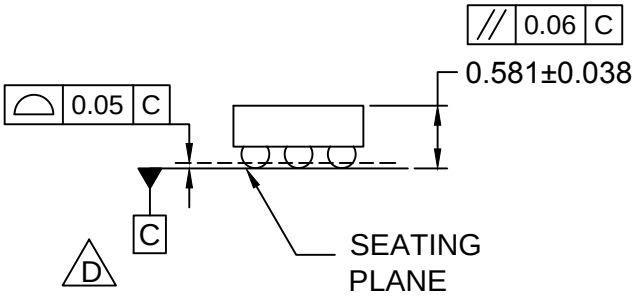
| E | D | X | Y |
|---|---|---|---|
| 1.215±.03 mm | 1.385±.03 mm | 0.2075 mm | 0.2925 mm |

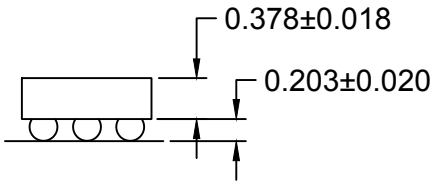



TOP VIEW

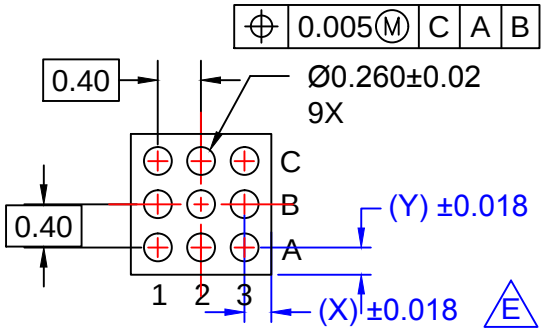



RECOMMENDED LAND PATTERN
(NSMD PAD TYPE)




SIDE VIEWS




BOTTOM VIEW

NOTES

A. NO JEDEC REGISTRATION APPLIES.
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCE PER ASME Y14.5M, 2009.
D. DATUM C IS DEFINED BY THE SPHERICAL CROWNS OF THE BALLS.
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