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# 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  $\Omega$  Typical
- $R_{ON}$  Flat: 0.01  $\Omega$  (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

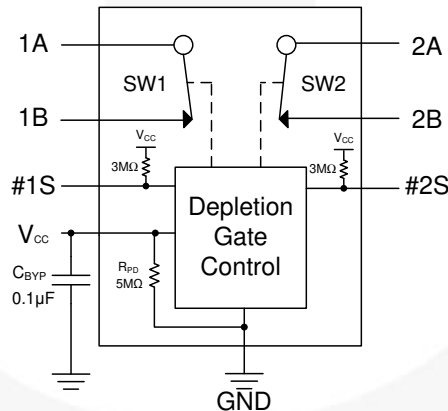


Figure 1. Top Level Block Diagram

### 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

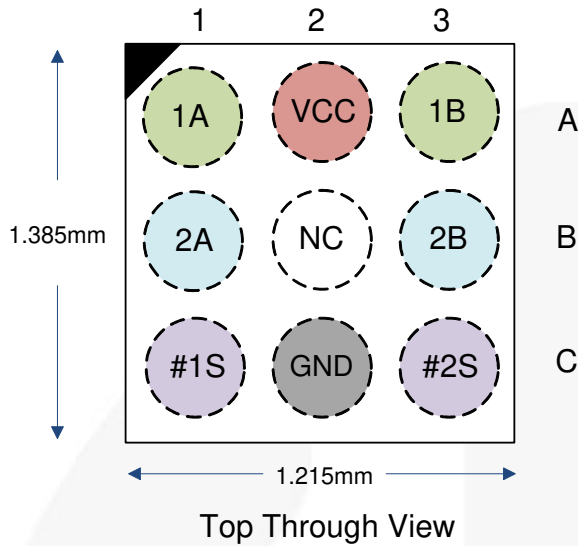


Figure 2. Top Through View

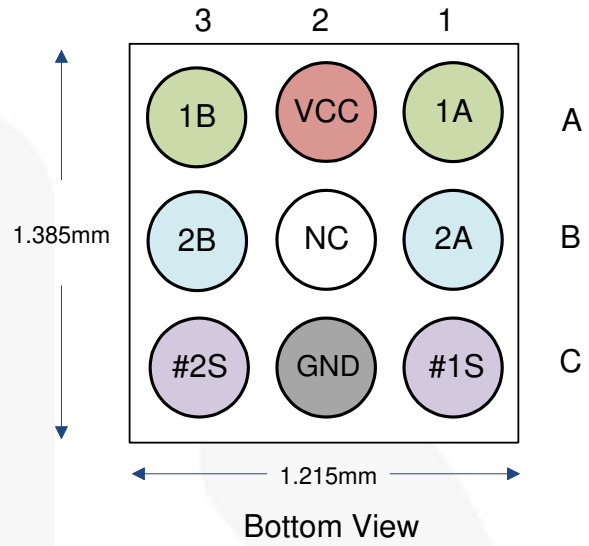


Figure 3. Bottom View

### 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 <sub>CC</sub>	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 <sub>CC</sub>	#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 <sub>BYP</sub>	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 <sub>CC</sub>	Supply/Control Voltage		-0.5	4.6	V
V <sub>CNTRL</sub>	Control Input Voltage	#1S, #2S	-0.5	4.6	V
V <sub>SW(ON)</sub>	DC Switch I/O Voltage (Switch Conducting)	1A, 1B, 2A, 2B	-0.5	3.3	V
V <sub>SW(OFF)</sub>	DC Switch I/O Voltage (Switch Isolated)	1A, 1B, 2A, 2B	-0.5	3.3	V
I <sub>SW</sub>	Switch I/O Current	V <sub>CC</sub> =0 V (Switch Conducting)		350	mA
I <sub>SWPEAK</sub>	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 <sub>A</sub>	Absolute Maximum Operating Temperature		-40	+85	°C
θ <sub>JA</sub>	Thermal Resistance, Junction-to-Ambient	2S2P JEDEC std. PCB		97	°C/W
T <sub>STG</sub>	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 <sub>CC(ON)</sub>	Supply Voltage with Depletion Switch Conducting (1A=1B; 2A=2B)		0	0.2	V
V <sub>CC(OFF)</sub>	Supply Voltage with Depletion Switch Isolated (1A≠1B; 2A≠2B; #1S=#2S=HIGH)		1.5	3.0	V
V <sub>SW(ON)</sub>	DC Switch I/O Voltage	Switch Conducting	-0.3	3.0	V
V <sub>SW(OFF)</sub>	DC Switch I/O Voltage	Switch Isolated	-0.3	3.0	V
V <sub>CNTRL</sub>	Control Input Voltage	#1S, #2S	0	3.0	V

## DC Electrical Characteristics

Unless otherwise specified, typical values are for  $T_A=25^\circ\text{C}$ .

Symbol	Parameter	Condition	$V_{CC}$ (V)	$T_A=-40^\circ\text{C}$ to $+85^\circ\text{C}$			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	$\mu\text{A}$
$I_{OFF}$	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	$\mu\text{A}$
$I_{CCT}$	Increase in $I_{CC}$ per Control Voltage	#1S or #2S=1.2 V	3.0		7	15	$\mu\text{A}$
$R_{ON}$	Switch On Resistance	$I_{SW}=100$ mA, $V_{SW}=-0.3$ V to 3 V	0		0.38	0.60	$\Omega$
$\Delta R_{ON}$	Switch On Resistance Difference, Channel to Channel	$I_{SW}=100$ mA, $V_{SW}=-0.3$ V to 3 V	0		0.01		$\Omega$
$R_{FLAT(ON)}$	On Resistance Flatness	$I_{SW}=100$ mA, $V_{SW}=-0.3$ V to 3 V	0		0.01		$\Omega$
$R_{PD}$	$V_{CC}$ Pull-Down Resistance		<0.2		5.0		M $\Omega$
$R_{PU}$	Control Pull-Up Resistance		<0.2		3.0		M $\Omega$
$I_{CC}$	Quiescent Supply Current	Switch Isolated, #1S=#2S= $V_{CC}$	1.5 - 3.0		70	120	$\mu\text{A}$
		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  $T_A=25^\circ\text{C}$ .

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

## Capacitance

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

## Oscillator Frequency

Symbol	Parameter	Condition	$V_{CC}$ (V)	$T_A=+25^\circ\text{C}$			Unit
				Min.	Typ.	Max.	
$f_{OSC}$	Oscillator Frequency <sup>(1)</sup>	Oscillator Enabled	1.8		775		kHz
$f_{OSC\%}$	Oscillator Frequency Tolerance Over Process & Temperature <sup>(1)</sup>	Oscillator Enabled	1.8			30	%

### Note:

- Parameters guaranteed by Design and Characterization.

Timing Diagrams

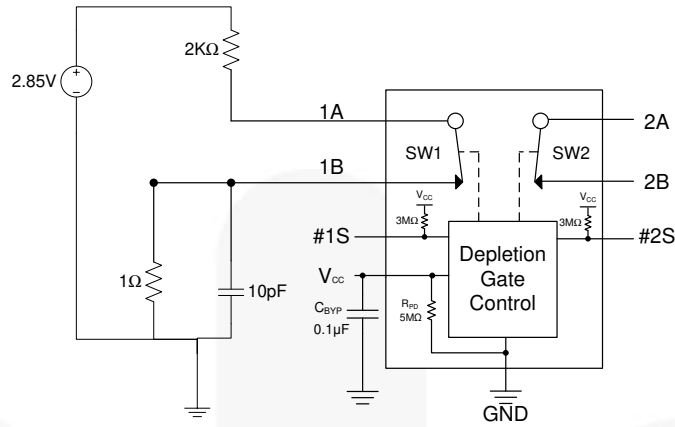


Figure 4.  $t_{ON}/t_{OFF}$ ,  $t_{ONS}/t_{OFF}$

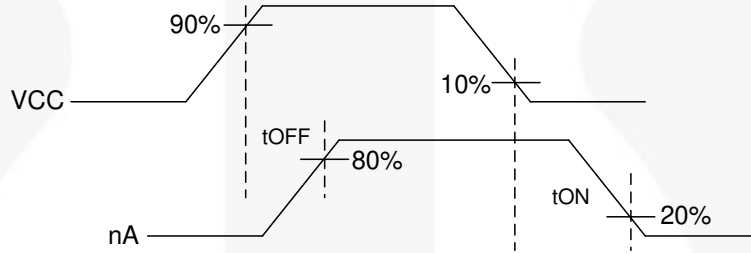


Figure 5. Turn-On / Turn-Off Timing

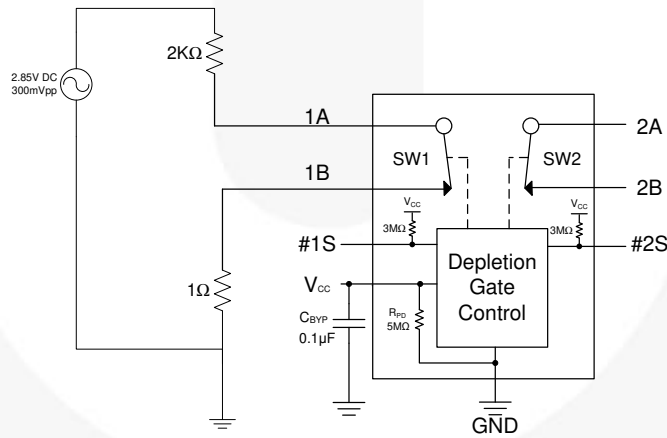


Figure 6. Off Isolation (B Port)

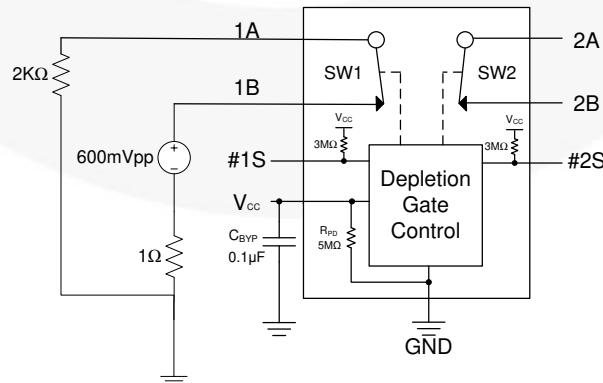


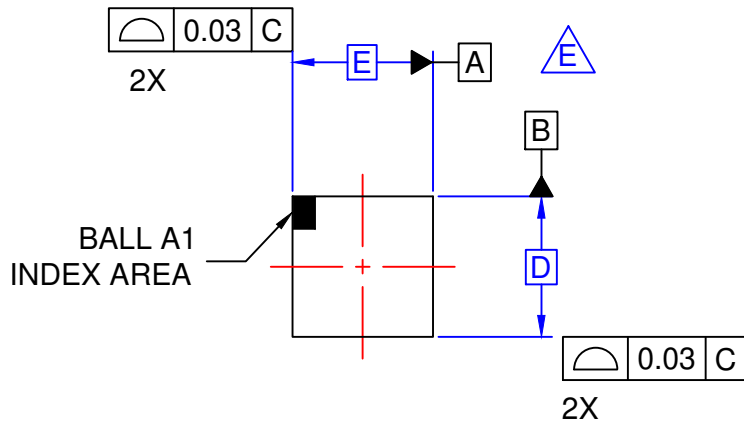
Figure 7. Off Isolation (A Port) / Cross Talk



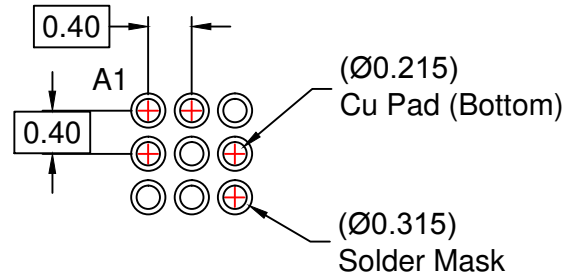
**Product-Specific Dimensions**

<b>E</b>	<b>D</b>	<b>X</b>	<b>Y</b>
1.215±.03 mm	1.385±.03 mm	0.2075 mm	0.2925 mm

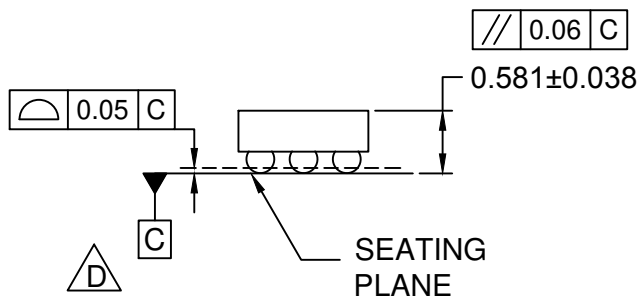




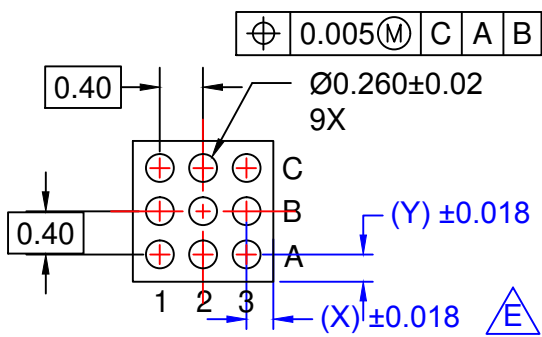
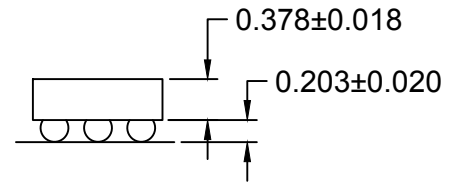
TOP VIEW



RECOMMENDED LAND PATTERN (NSMD PAD TYPE)



SIDE VIEWS



BOTTOM VIEW

NOTES

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- C. DIMENSIONS AND TOLERANCE PER ASME Y14.5M, 2009.
- D. DATUM C IS DEFINED BY THE SPHERICAL CROWNS OF THE BALLS.
- E. FOR DIMENSIONS D, E, X, AND Y SEE PRODUCT DATASHEET.
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