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April 2015

# FSA553 Dual SPST Depletion Audio Switch with Negative Swing

## Features

- Dual SPST Depletion Switch
- Normally Closed when  $V_{CC} < 0.2\text{ V}$
- Switches Configurable through Select Pins
- $V_{SW}$ : -1.5 V to +1.5 V
- $R_{ON}$ : 0.4  $\Omega$  (Typical)
- $R_{FLAT}$  < 0.01  $\Omega$  (Typical)
- THD+N: -104 dB (Typical)
- OIRR: -78 dB (Typical)

## Description

The FSA553 is a high-performance dual single-pole single-throw (SPST x 2) audio switch. The Depletion 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 gate control allows the FSA553 to achieve excellent THD+N performance while consuming minimal power.

## Related Resources

- FSA553 Evaluation Board

## Applications

- Smart Phones
- Tablets, Ultra Books

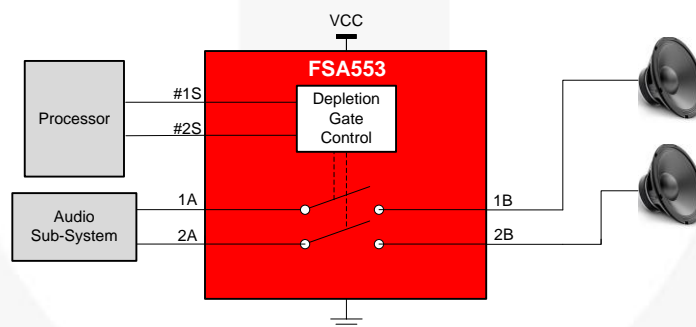


Figure 1. Application Block Diagram

## Ordering Information

Part Number	Operating Temperature Range	Top Mark	Package	Packing Method
FSA553UCX	-40 to 85°C	NG	9-Ball WLCSP, 0.40 mm Pitch, 1.215 x 1.385 x 0.58 mm (Nominal)	3000 Units on Tape & Reel

## Pin Configuration

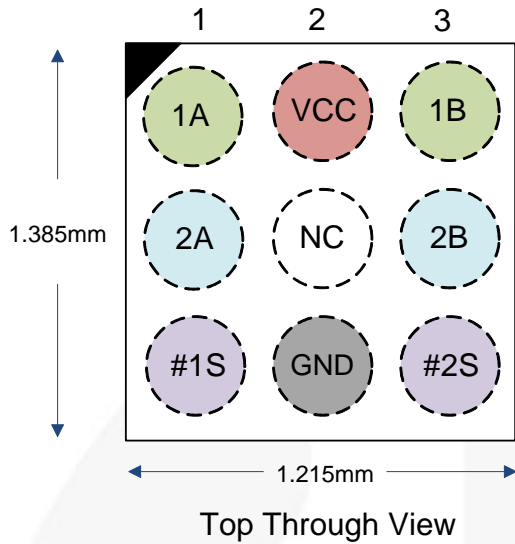


Figure 2. Top Through View

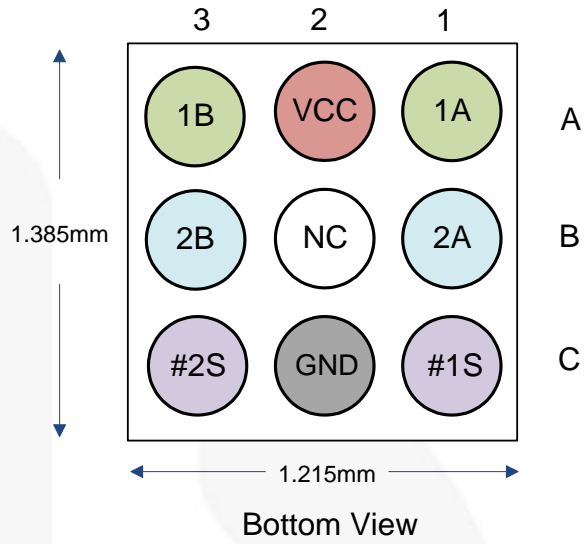


Figure 3. Bottom View

## 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 / Control	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. Switch 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

## 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	4.3	V
V <sub>CNTRL</sub>	Select Input Voltage	#1S, #2S	-0.5	4.3	V
V <sub>SW(ON)</sub>	DC Switch I/O Voltage (Switch Conducting)	1A, 1B, 2A, 2B	-2.0	2.0	V
V <sub>SW(OFF)</sub>	DC Switch I/O Voltage (Switch Isolated)	1A, 1B, 2A, 2B	-2.0	2.0	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		4	
	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	-1.5	1.5	V
V <sub>SW(OFF)</sub>	DC Switch I/O Voltage	Switch Isolated	-1.5	1.5	V
V <sub>CNTRL</sub>	Select 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 ON Leakage Current	nA=-0.5 V, 0.5 V, 1.5 V, -1.5 V, nB=Float, #1S=#2S=Float	0		0.1		$\mu\text{A}$
$I_{OFF}$	Switch OFF Leakage Current	nA=-0.5 V, 0.5 V, 1.5 V, -1.5 V, nB=GND, #1S=#2S= $V_{CC}$	1.8		0.5		$\mu\text{A}$
$I_{CCT}$	Increase in $I_{CC}$ for each Select Pin	#1S= $V_{CC}$ , #2S=1.2 V, #1S=1.2 V, #2S= $V_{CC}$	3.0		7		$\mu\text{A}$
$R_{ON}$	Switch On Resistance	$I_{SW}=100$ mA, $V_{SW}=-1.5$ V to +1.5 V	0		0.40	0.80	$\Omega$
$\Delta R_{ON}$	Switch On Resistance Difference, Channel to Channel	$I_{SW}=100$ mA, $V_{SW}=-1.5$ V to +1.5 V	0		0.01		$\Omega$
$R_{FLAT(ON)}$	On Resistance Flatness	$I_{SW}=100$ mA, $V_{SW}=-1.5$ V to +1.5 V	0		0.01		$\Omega$
$R_{PD}$	$V_{CC}$ Pull-Down Resistance		<0.2		5.0		M $\Omega$
$R_{PU}$	Select Pull-Up Resistance		<0.2		3.0		M $\Omega$
$I_{CC}$	Quiescent Supply Current	#1S=#2S=0 V or Float	Switch Isolated	1.5 – 3.0	80		$\mu\text{A}$
			Switch Conducting	0.2	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  $T_A=25^\circ\text{C}$ .

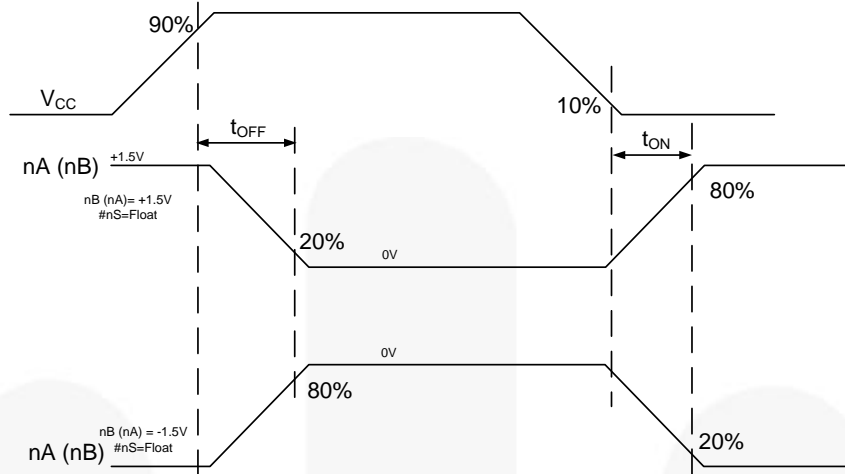
Symbol	Parameter	Condition	$V_{CC}$ (V)	$T_A=-40^\circ\text{C}$ to $+85^\circ\text{C}$			Unit	
				Min.	Typ.	Max.		
$t_{ON}$	Turn-On Time $V_{CC}$ to Output	$R_L=32\ \Omega$ , $C_L=10\ \text{pF}$ , #nS=Float, Figure 4	$V_{SW}=1.5\ \text{V}$	1.8 → 0		450	$\mu\text{s}$	
			$V_{SW}=-1.5\ \text{V}$	1.8 → 0		350		
$t_{OFF}$	Turn-Off Time $V_{CC}$ to Output	$R_L=32\ \Omega$ , $C_L=10\ \text{pF}$ , #nS=Float, Figure 4	$V_{SW}=1.5\ \text{V}$	0 → 1.8		250	$\mu\text{s}$	
			$V_{SW}=-1.5\ \text{V}$	0 → 1.8		150		
$t_{ONS}$	Turn-On Time Select Pin	$R_L=32\ \Omega$ , $C_L=10\ \text{pF}$ , #nS= $V_{CC} \rightarrow 0$ , Figure 5	$V_{SW}=1.5\ \text{V}$	1.8		350	$\mu\text{s}$	
			$V_{SW}=-1.5\ \text{V}$	1.8		300		
$t_{OFFS}$	Turn-Off Time Select Pin	$R_L=32\ \Omega$ , $C_L=10\ \text{pF}$ , #nS=0 → $V_{CC}$ , Figure 5	$V_{SW}=1.5\ \text{V}$	1.8		150	$\mu\text{s}$	
			$V_{SW}=-1.5\ \text{V}$	1.8		50		
BW	-3 dB Bandwidth	$V_{SW}=600\ \text{mV}_{p-p}$ , $R_L=50\ \Omega$ ; $C_L=5\ \text{pF}$ ,	0			200	MHz	
THD+N	Total Harmonic Distortion + Noise	$V_{SW}=1\ V_{RMS}$ , $R_L=32\ \Omega$ , $f=1\ \text{kHz}$	Non A-weighted	0		-104	dB	
			A-weighted			-107	dB	
$O_{IRR}$	Port Off Isolation	$V_{SW}=0.707\ V_{RMS}$ , $R_L=32\ \Omega$ , $f=20\ \text{Hz}$ to 100 kHz, Figure 6	1.8	-70		-82	dB	
$X_{TALK}$	Cross Talk	$V_{SW}=1\ V_{RMS}$ , $f=100\ \text{kHz}$ , $R_L=32\ \Omega$	1.8			-75	dB	
		$V_{SW}=1\ V_{RMS}$ , $f=20\ \text{kHz}$ , $R_L=32\ \Omega$				-100		
PSRR	Power Supply Rejection Ratio	Switch Isolating, $V_{Ripple}=V_{CC}+300\ \text{mV}_{p-p}$ , $R_L=32\ \Omega$	217Hz	1.8			-80	dB
			1 kHz				-77	
			20 kHz				-73	

## Capacitance

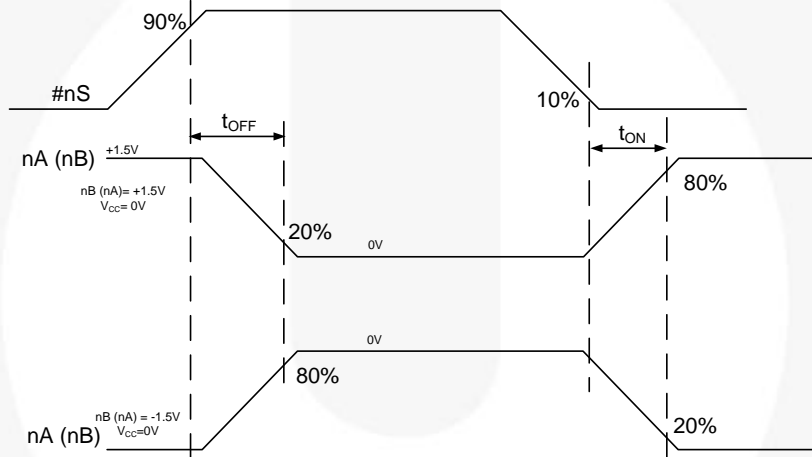
Unless otherwise specified, typical values are for  $T_A=25^\circ\text{C}$ .

Symbol	Parameter	Condition	$V_{CC}$ (V)	$T_A=-40^\circ\text{C}$ to $+85^\circ\text{C}$			Unit
				Min.	Typ.	Max.	
$C_{ON}$	On Capacitance	$V_{SW}=400\ \text{mV}_{PP}$ , $f=1\ \text{MHz}$ ,	0		21		pF
$C_{OFF}$	Off Capacitance	$V_{SW}=400\ \text{mV}_{PP}$ , $f=1\ \text{MHz}$ , #1S=#2S= $V_{CC}$	1.8		25		pF
$C_{CTRL}$	Select Pin Capacitance	#nS= $400\ \text{mV}_{PP}$ , $f=1\ \text{MHz}$ ,	1.8		5		pF

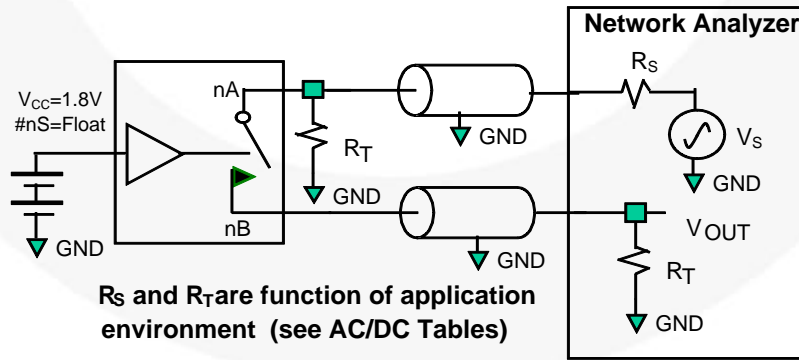
### Timing Diagrams



**Figure 4.  $t_{ON}/t_{OFF}$   $V_{CC}$  to Output Timing**



**Figure 5.  $t_{ON}/t_{OFF}$  Select (#nS) to Output Timing**



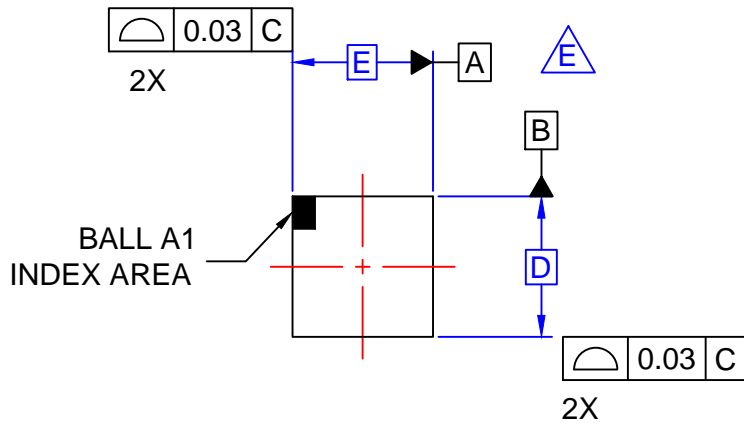
$R_s$  and  $R_T$  are function of application environment (see AC/DC Tables)

$$\text{OFF Isolation} = 20 \text{ Log } (V_{OUT}/V_{IN})$$

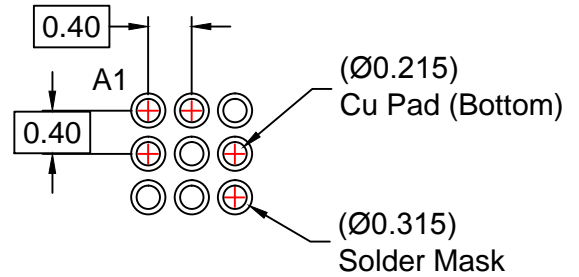
**Figure 6. OFF Isolation**

### Product-Specific Dimensions

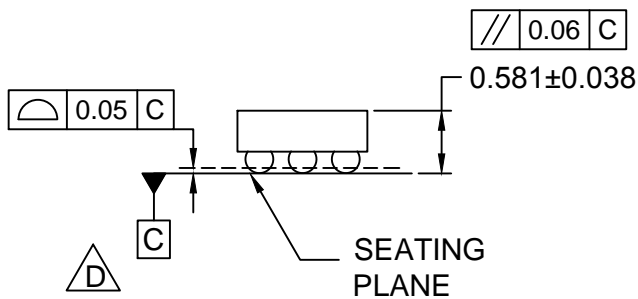
E	D	X	Y
1.215±.03 mm	1.385±.03 mm	0.2075 mm	0.2925 mm



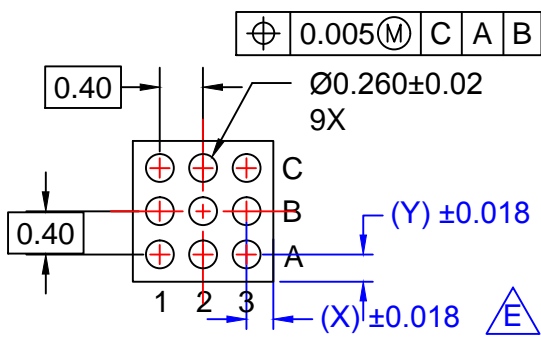
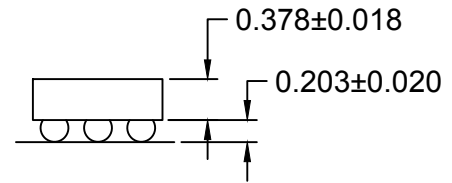
TOP VIEW



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.
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