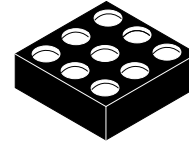


# Dual SPST Depletion Audio Switch with Negative Swing

## FSA553



WLCSP9 1.385x1.215x0.581  
CASE 567SV

### 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 VCC available and to isolate signals when VCC is present. During signal conduction, the Depletion gate control allows the FSA553 to achieve excellent THD+N performance while consuming minimal power.

### Features

- Dual SPST Depletion Switch
- Normally Closed when VCC < 0.2 V
- Switches Configurable through Select Pins
- V<sub>SW</sub>: -1.5 V to +1.5 V
- R<sub>ON</sub>: 0.4 Ω (Typical)
- R<sub>FLAT</sub> < 0.01 Ω (Typical)
- THD+N: -104 dB (Typical)
- OIRR: -78 dB (Typical)
- This Device is Pb-Free and Halide Free

### Table of Contents

- FSA553 Evaluation Board

### Applications

- Smart Phones
- Tablets, Ultra Books

### Block Diagram

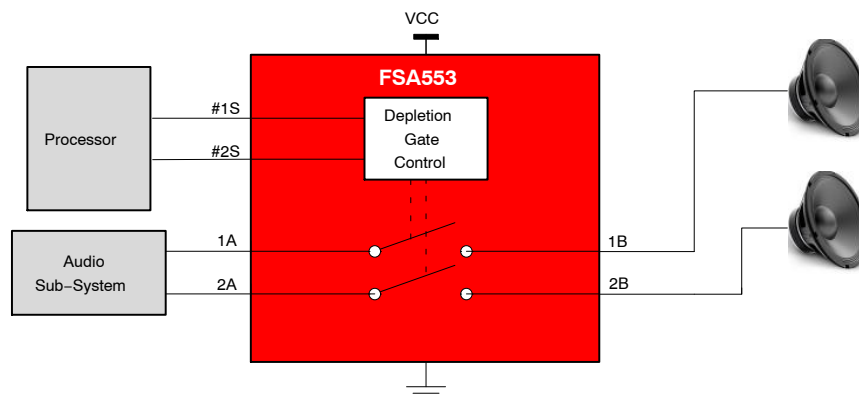


Figure 1. Application Block Diagram

### MARKING DIAGRAM



NG = Specific Device Code  
 &K = 2-Digits Lot Run Traceability Code  
 &. = Pin One Dot  
 &2 = 2-Digit Date Code  
 &Z = Assembly Plant Code

\*Date Code orientation and/or position may vary depending upon manufacturing location.

### ORDERING INFORMATION

| Device    | Package          | Shipping <sup>†</sup> |
|-----------|------------------|-----------------------|
| FSA553UCX | WLCSP9 (Pb-Free) | 3000 / Tape & Reel    |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](http://www.onsemi.com/BRD8011/D).

## Pin Configuration

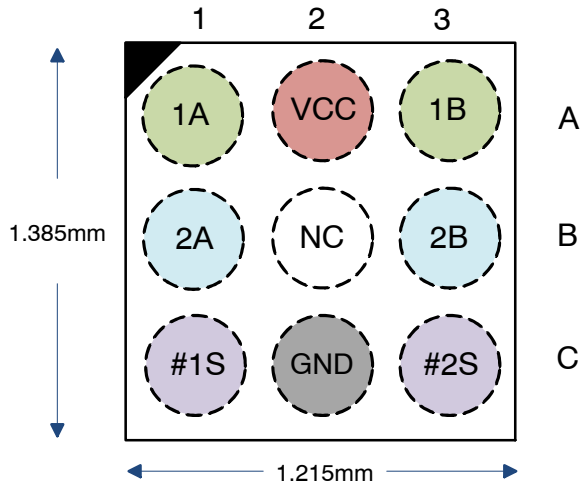


Figure 2. Top Through View

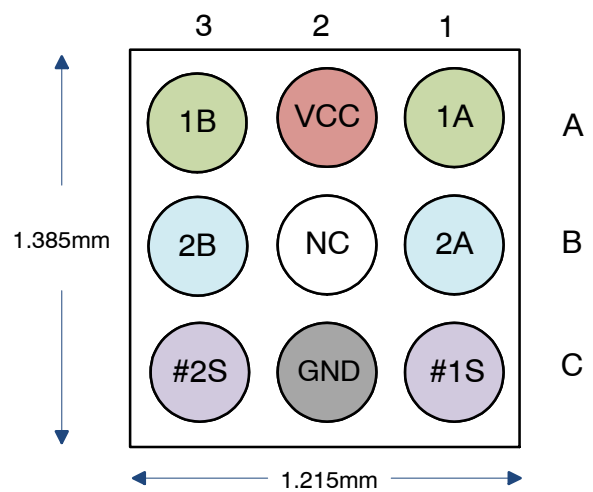


Figure 3. Bottom View

## PIN DESCRIPTION

| 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) |

## 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**

| 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 C 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,<br>< 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   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

**RECOMMENDED OPERATING CONDITIONS**

| 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 Input Voltage                                                        | Switch Conducting | −1.5 | 1.5 | V    |
| V <sub>SW(OFF)</sub> | DC Switch I/O Input Voltage                                                        | Switch Isolated   | −1.5 | 1.5 | V    |
| V <sub>CNTRL</sub>   | Select Input Voltage                                                               | #1S, #2S          | 0    | 3.0 | V    |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

# FSA553

## DC ELECTRICAL CHARACTERISTICS (Typical values are for $T_A = 25^\circ\text{C}$ unless otherwise specified.)

| 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,<br>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,<br>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,<br>#1S = 1.2 V, #2S = $V_{CC}$          | 3.0          |                                                 | 7    |      | $\mu\text{A}$ |
| $R_{ON}$        | Switch On Resistance                                | $I_{SW} = 100\text{ mA}$ , $V_{SW} = -1.5\text{ V to } +1.5\text{ V}$ | 0            |                                                 | 0.40 | 0.80 | $\Omega$      |
| $\Delta R_{ON}$ | Switch On Resistance Difference, Channel to Channel | $I_{SW} = 100\text{ mA}$ , $V_{SW} = -1.5\text{ V to } +1.5\text{ V}$ | 0            |                                                 | 0.01 |      | $\Omega$      |
| $R_{FLAT(ON)}$  | On Resistance Flatness                              | $I_{SW} = 100\text{ mA}$ , $V_{SW} = -1.5\text{ V to } +1.5\text{ V}$ | 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                            | Switch Isolated, #1S = #2S = $V_{CC}$                                 | 1.5 to 3.0   |                                                 | 80   |      | $\mu\text{A}$ |
|                 |                                                     | Switch On                                                             | 0.2          |                                                 | 0.5  |      |               |
| $V_{IH}$        | Select Pin Input High Voltage                       |                                                                       | 1.5 to 3.0   | 1.2                                             |      |      | V             |
| $V_{IL}$        | Select Pin Input Low Voltage                        |                                                                       | 1.5 to 3.0   |                                                 |      | 0.55 | V             |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

# FSA553

## AC ELECTRICAL CHARACTERISTICS (Typical values are for $T_A = 25^\circ\text{C}$ unless otherwise specified.)

| 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   | $R_L = 32\ \Omega$ , $C_L = 10\ \text{pF}$ ,<br>#nS = Float, Figure 4                               | $W_{SW} = 1.5\ \text{V}$  | 1.8→0                                           | 450  |     | $\mu\text{s}$ |
|                   |                                   |                                                                                                     | $W_{SW} = -1.5\ \text{V}$ | 1.8→0                                           | 350  |     |               |
| $t_{OFF}$         | Turn-Off Time $V_{CC}$ to Output  | $R_L = 32\ \Omega$ , $C_L = 10\ \text{pF}$ ,<br>#nS = Float, Figure 4                               | $W_{SW} = 1.5\ \text{V}$  | 0→1.8                                           | 250  |     | $\mu\text{s}$ |
|                   |                                   |                                                                                                     | $W_{SW} = -1.5\ \text{V}$ | 0→1.8                                           | 150  |     |               |
| $t_{ONS}$         | Turn-On Time Select Pin           | $R_L = 32\ \Omega$ , $C_L = 10\ \text{pF}$ ,<br>#nS = $V_{CC} \rightarrow 0$ , Figure 5             | $W_{SW} = 1.5\ \text{V}$  | 1.8                                             | 350  |     | $\mu\text{s}$ |
|                   |                                   |                                                                                                     | $W_{SW} = -1.5\ \text{V}$ | 1.8                                             | 300  |     |               |
| $t_{OFFS}$        | Turn-Off Time Select Pin          | $R_L = 32\ \Omega$ , $C_L = 10\ \text{pF}$ ,<br>#nS = $0 \rightarrow V_{CC}$ , Figure 5             | $W_{SW} = 1.5\ \text{V}$  | 1.8                                             | 150  |     | $\mu\text{s}$ |
|                   |                                   |                                                                                                     | $W_{SW} = -1.5\ \text{V}$ | 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 | $V_{SW} = 1\ \text{V}_{RMS}$ , $R_L = 32\ \Omega$ ,<br>$f = 1\ \text{kHz}$                          | 0                         |                                                 | -104 |     | dB            |
|                   |                                   |                                                                                                     |                           |                                                 | -107 |     | dB            |
| O <sub>IRR</sub>  | Port Off Isolation                | $V_{SW} = 0.707\ \text{V}_{RMS}$ , $R_L = 32\ \Omega$ , $f = 20\ \text{Hz}$ to<br>100 kHz, Figure 6 | 1.8                       | -70                                             | -82  |     | dB            |
| X <sub>TALK</sub> | Cross Talk                        | $V_{SW} = 1\ \text{V}_{RMS}$ , $f = 100\ \text{kHz}$ , $R_L = 32\ \Omega$                           | 1.8                       |                                                 | -75  |     | dB            |
|                   |                                   | $V_{SW} = 1\ \text{V}_{RMS}$ , $f = 20\ \text{kHz}$ , $R_L = 32\ \Omega$                            |                           |                                                 | -100 |     |               |
| PSRR              | Power Supply Rejection Ratio      | Switch Isolating,<br>$V_{Ripple} = V_{CC} + 300\ \text{mV}_{p-p}$ ,<br>$R_L = 32\ \Omega$           | 1.8                       |                                                 | -80  |     | dB            |
|                   |                                   |                                                                                                     |                           |                                                 | -77  |     |               |
|                   |                                   |                                                                                                     |                           |                                                 | -73  |     |               |

## CAPACITANCE (Typical values are for $T_A = 25^\circ\text{C}$ unless otherwise specified.)

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

# FSA553

## TIMING DIAGRAMS

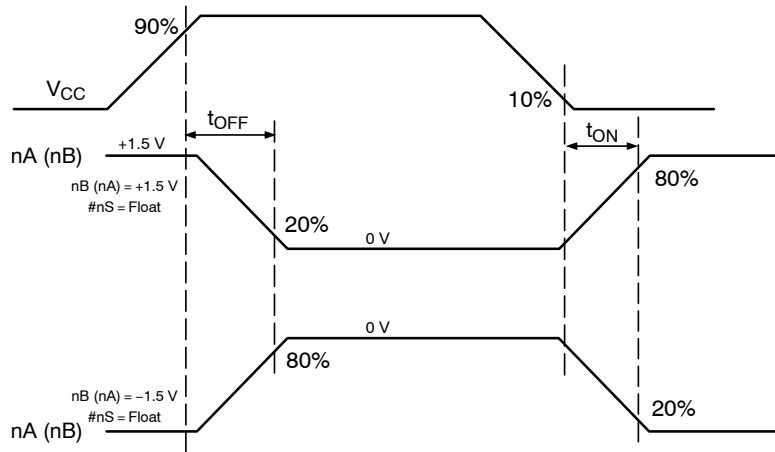


Figure 4.  $t_{ON}/t_{OFF}$   $V_{CC}$  to Output Timing

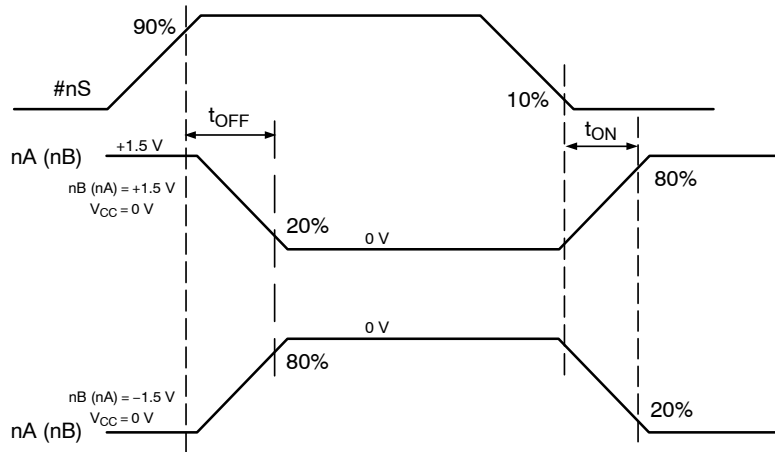


Figure 5.  $t_{ON}/t_{OFF}$  Select ( $\#nS$ ) to Output Timing

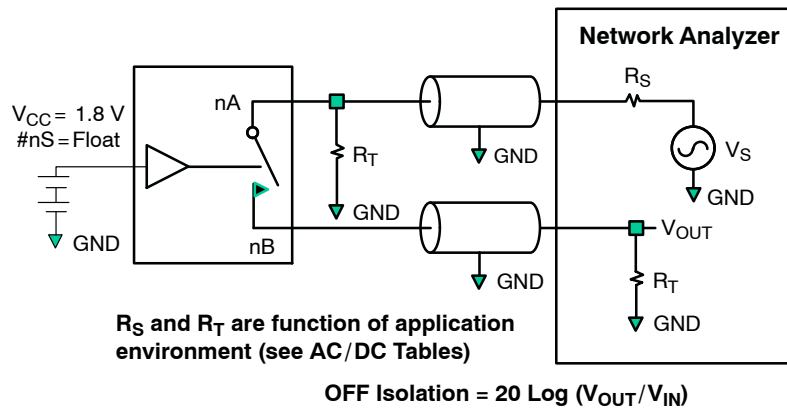


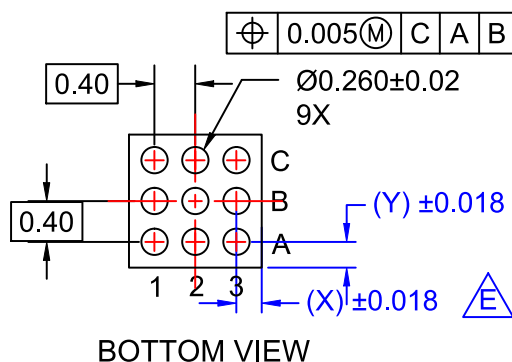
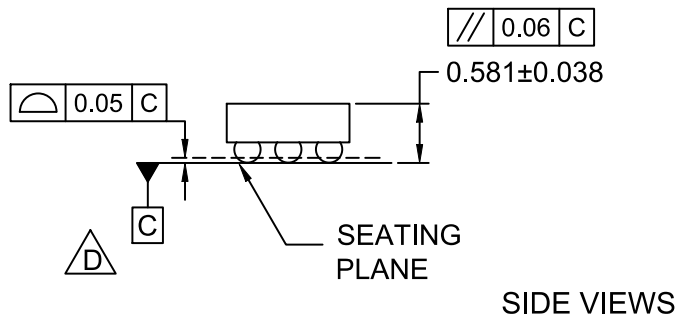
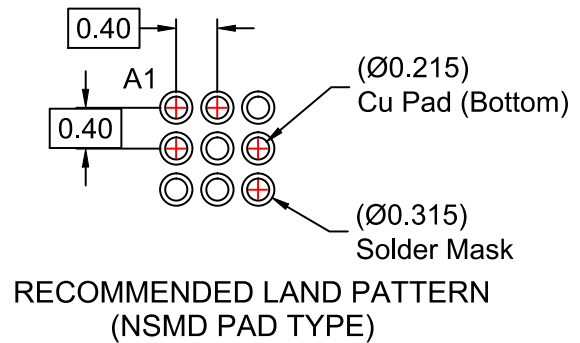
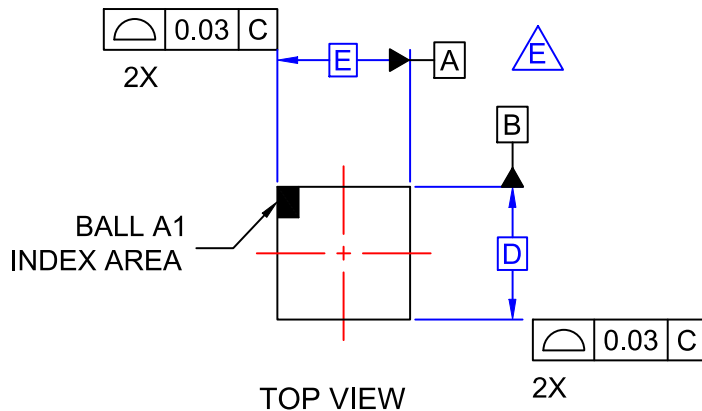
Figure 6. OFF Isolation

## PRODUCT-SPECIFIC DIMENSIONS

| E             | D             | X      | Y      |
|---------------|---------------|--------|--------|
| 1.215±0.03 mm | 1.385±0.03 mm | 0.2075 | 0.2925 |

**WLCSP9 1.385x1.215x0.581**  
CASE 567SV  
ISSUE O

DATE 30 NOV 2016



**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.
- E. FOR DIMENSIONS D,E,X, AND Y SEE PRODUCT DATASHEET.

|                         |                                 |                                                                                                                                                                                  |
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