



# Low Capacitance, 4-/8-Channel $\pm 15$ V/+12 V $\text{iCMOS}^{\text{TM}}$ Multiplexers

## ADG1208/ADG1209

### FEATURES

- <1 pC charge injection over full signal range
- 1 pF off capacitance
- 33 V supply range
- 120  $\Omega$  on resistance
- Fully specified at  $\pm 15$  V/+12 V
- 3 V logic compatible inputs
- Rail-to-rail operation
- Break-before-make switching action
- Available in 16-lead TSSOP and 4 mm  $\times$  4 mm LFCSP\_VQ
- Typical power consumption < 0.03  $\mu$ W

### APPLICATIONS

- Audio and video routing
- Automatic test equipment
- Data-acquisition systems
- Battery-powered systems
- Sample-and-hold systems
- Communication systems

### GENERAL DESCRIPTION

The ADG1208 and ADG1209 are monolithic,  $\text{iCMOS}$  analog multiplexers comprising eight single channels and four differential channels, respectively. The ADG1208 switches one of eight inputs to a common output as determined by the 3-bit binary address lines A0, A1, and A2. The ADG1209 switches one of four differential inputs to a common differential output as determined by the 2-bit binary address lines A0 and A1. An EN input on both devices is used to enable or disable the device. When disabled, all channels are switched off. When on, each channel conducts equally well in both directions and has an input signal range that extends to the supplies.

The  $\text{iCMOS}$  (industrial CMOS) modular manufacturing process combines high voltage CMOS (complementary metal-oxide semiconductor) and bipolar technologies. It enables the development of a wide range of high performance analog ICs capable of 33 V operation in a footprint that no other generation of high voltage parts has been able to achieve. Unlike analog ICs using conventional CMOS processes,  $\text{iCMOS}$  components can tolerate high supply voltages while providing increased performance, dramatically lower power consumption, and reduced package size.

### FUNCTIONAL BLOCK DIAGRAMS

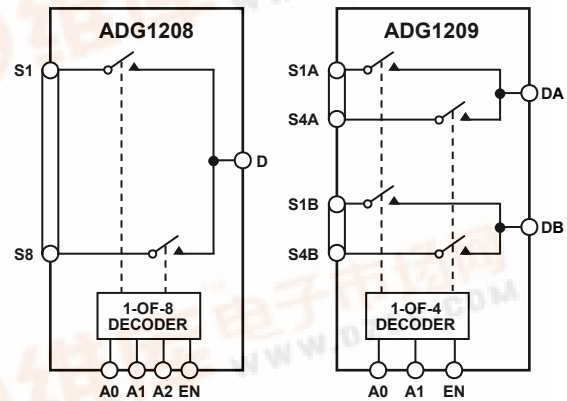


Figure 1.

The ultralow capacitance and exceptionally low charge injection of these multiplexers make them ideal solutions for data acquisition and sample-and-hold applications, where low glitch and fast settling are required. Figure 2 shows that there is minimum charge injection over the entire signal range of the device.  $\text{iCMOS}$  construction also ensures ultralow power dissipation, making the parts ideally suited for portable and battery powered instruments.

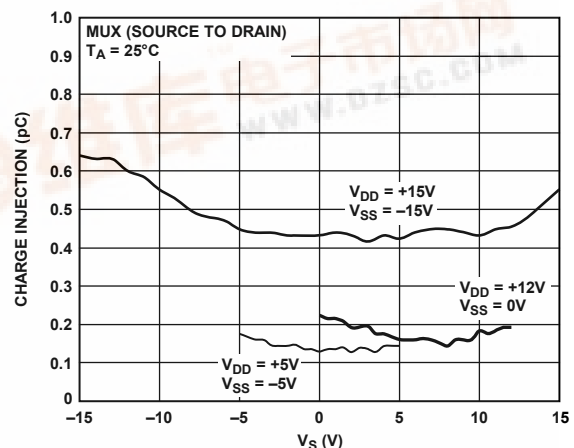


Figure 2. Source to Drain Charge Injection vs. Source Voltage



ADG1208/ADG1209

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REVISION HISTORY

4/06—Revision 0: Initial Version

## SPECIFICATIONS

### DUAL SUPPLY

$V_{DD} = +15\text{ V} \pm 10\%$ ,  $V_{SS} = -15\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ , unless otherwise noted.<sup>1</sup>

Table 1.

| Parameter                                             | +25°C       | –40°C to<br>+85°C | –40°C to<br>+125°C   | Unit              | Test Conditions/Comments                                                                             |
|-------------------------------------------------------|-------------|-------------------|----------------------|-------------------|------------------------------------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                  |             |                   |                      |                   |                                                                                                      |
| Analog Signal Range                                   |             |                   | $V_{SS}$ to $V_{DD}$ | V                 |                                                                                                      |
| On Resistance, $R_{ON}$                               | 120         |                   |                      | $\Omega$ typ      | $V_S = \pm 10\text{ V}$ , $I_S = -1\text{ mA}$ , see Figure 29                                       |
|                                                       | 200         | 240               | 270                  | $\Omega$ max      | $V_{DD} = +13.5\text{ V}$ , $V_{SS} = -13.5\text{ V}$                                                |
| On Resistance Match Between Channels, $\Delta R_{ON}$ | 3.5         |                   |                      | $\Omega$ typ      | $V_S = \pm 10\text{ V}$ , $I_S = -1\text{ mA}$                                                       |
|                                                       | 6           | 10                | 12                   | $\Omega$ max      |                                                                                                      |
| On Resistance Flatness, $R_{FLAT}$ (On)               | 20          |                   |                      | $\Omega$ typ      | $V_S = -5\text{ V}$ , $0\text{ V}$ , $+5\text{ V}$ , $I_S = -1\text{ mA}$                            |
|                                                       | 64          | 76                | 83                   | $\Omega$ max      |                                                                                                      |
| <b>LEAKAGE CURRENTS</b>                               |             |                   |                      |                   |                                                                                                      |
| Source Off Leakage, $I_S$ (Off)                       | $\pm 0.02$  |                   |                      | nA typ            | $V_D = \pm 10\text{ V}$ , $V_S = -10\text{ V}$ , see Figure 30                                       |
|                                                       | $\pm 0.1$   | $\pm 0.6$         | $\pm 1$              | nA max            |                                                                                                      |
| Drain Off Leakage, $I_D$ (Off)                        | $\pm 0.02$  |                   |                      | nA typ            | $V_S = 1\text{ V}$ , $10\text{ V}$ ; $V_D = 10\text{ V}$ , $1\text{ V}$ ; see Figure 30              |
| ADG1208                                               | $\pm 0.1$   | $\pm 0.6$         | $\pm 1$              | nA max            |                                                                                                      |
| ADG1209                                               | $\pm 0.1$   | $\pm 0.6$         | $\pm 1$              | nA max            |                                                                                                      |
| Channel On Leakage, $I_D$ , $I_S$ (On)                | $\pm 0.02$  |                   |                      | nA typ            | $V_S = V_D = \pm 10\text{ V}$ , see Figure 31                                                        |
| ADG1208                                               | $\pm 0.2$   | $\pm 0.6$         | $\pm 1$              | nA max            |                                                                                                      |
| ADG1209                                               | $\pm 0.2$   | $\pm 0.6$         | $\pm 1$              | nA max            |                                                                                                      |
| <b>DIGITAL INPUTS</b>                                 |             |                   |                      |                   |                                                                                                      |
| Input High Voltage, $V_{INH}$                         |             |                   | 2.0                  | V min             |                                                                                                      |
| Input Low Voltage, $V_{INL}$                          |             |                   | 0.8                  | V max             |                                                                                                      |
| Input Current, $I_{INL}$ or $I_{INH}$                 | $\pm 0.005$ |                   |                      | $\mu\text{A}$ max | $V_{IN} = V_{INL}$ or $V_{INH}$                                                                      |
|                                                       |             |                   | $\pm 0.1$            | $\mu\text{A}$ max |                                                                                                      |
| Digital Input Capacitance, $C_{IN}$                   | 2           |                   |                      | pF typ            |                                                                                                      |
| <b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>            |             |                   |                      |                   |                                                                                                      |
| Transition Time, $t_{TRANSITION}$                     | 80          |                   |                      | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$                                                           |
|                                                       | 130         | 165               | 185                  | ns max            | $V_S = 10\text{ V}$ , see Figure 32                                                                  |
| $t_{ON}$ (EN)                                         | 75          |                   |                      | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$                                                           |
|                                                       | 95          | 105               | 115                  | ns max            | $V_S = 10\text{ V}$ , see Figure 34                                                                  |
| $t_{OFF}$ (EN)                                        | 83          |                   |                      | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$                                                           |
|                                                       | 100         | 125               | 140                  | ns max            | $V_S = 10\text{ V}$ , see Figure 34                                                                  |
| Break-Before-Make Time Delay, $t_{BBM}$               | 25          |                   |                      | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$                                                           |
|                                                       |             |                   | 10                   | ns min            | $V_{S1} = V_{S2} = 10\text{ V}$ , see Figure 33                                                      |
| Charge Injection                                      | 0.4         |                   |                      | pC typ            | $V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ , see Figure 35                         |
| Off Isolation                                         | –85         |                   |                      | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , see Figure 36                        |
| Channel-to-Channel Crosstalk                          | –85         |                   |                      | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , see Figure 38                        |
| Total Harmonic Distortion + Noise                     | 0.15        |                   |                      | % typ             | $R_L = 10\text{ k}\Omega$ , $5\text{ V rms}$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$ , see Figure 39 |
| –3 dB Bandwidth                                       | 550         |                   |                      | MHz typ           | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , see Figure 37                                             |
| $C_S$ (Off)                                           | 1           |                   |                      | pF typ            | $f = 1\text{ MHz}$ , $V_S = 0\text{ V}$                                                              |
|                                                       | 1.5         |                   |                      | pF max            | $f = 1\text{ MHz}$ , $V_S = 0\text{ V}$                                                              |
| $C_D$ (Off) ADG1208                                   | 6           |                   |                      | pF typ            | $f = 1\text{ MHz}$ , $V_S = 0\text{ V}$                                                              |
|                                                       | 7           |                   |                      | pF max            | $f = 1\text{ MHz}$ , $V_S = 0\text{ V}$                                                              |
| $C_D$ (Off) ADG1209                                   | 3.5         |                   |                      | pF typ            | $f = 1\text{ MHz}$ , $V_S = 0\text{ V}$                                                              |
|                                                       | 4.5         |                   |                      | pF max            | $f = 1\text{ MHz}$ , $V_S = 0\text{ V}$                                                              |

# ADG1208/ADG1209

| Parameter                                    | +25°C | –40°C to<br>+85°C | –40°C to<br>+125°C | Unit             | Test Conditions/Comments                             |
|----------------------------------------------|-------|-------------------|--------------------|------------------|------------------------------------------------------|
| C <sub>D</sub> , C <sub>S</sub> (On) ADG1208 | 7     |                   |                    | pF typ           | f = 1 MHz, V <sub>S</sub> = 0 V                      |
|                                              | 8     |                   |                    | pF max           | f = 1 MHz, V <sub>S</sub> = 0 V                      |
| C <sub>D</sub> , C <sub>S</sub> (On) ADG1209 | 5     |                   |                    | pF typ           | f = 1 MHz, V <sub>S</sub> = 0 V                      |
|                                              | 6     |                   |                    | pF max           | f = 1 MHz, V <sub>S</sub> = 0 V                      |
| POWER REQUIREMENTS                           |       |                   |                    |                  | V <sub>DD</sub> = +16.5 V, V <sub>SS</sub> = –16.5 V |
| I <sub>DD</sub>                              | 0.002 |                   | 1.0                | μA typ<br>μA max | Digital inputs = 0 V or V <sub>DD</sub>              |
| I <sub>DD</sub>                              | 220   |                   | 320                | μA typ<br>μA max | Digital inputs = 5 V                                 |
| I <sub>SS</sub>                              | 0.002 |                   | 1.0                | μA typ<br>μA max | Digital inputs = 0 V or V <sub>DD</sub>              |
| I <sub>SS</sub>                              | 0.002 |                   | 1.0                | μA typ<br>μA max | Digital inputs = 5 V                                 |
| V <sub>DD</sub> /V <sub>SS</sub>             |       |                   | ±5/±16.5           | V min/max        | V <sub>DD</sub>   =  V <sub>SS</sub>                 |

<sup>1</sup> Temperature range is as follows: Y version: –40°C to +125°C.

<sup>2</sup> Guaranteed by design, not subject to production test.

**SINGLE SUPPLY**

$V_{DD} = 12\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$ , unless otherwise noted.<sup>1</sup>

**Table 2.**

| Parameter                                             | +25°C       | −40°C to<br>+85°C | −40°C to<br>+125°C | Unit              | Test Conditions/Comments                                                        |
|-------------------------------------------------------|-------------|-------------------|--------------------|-------------------|---------------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                  |             |                   |                    |                   |                                                                                 |
| Analog Signal Range                                   |             |                   | 0 to $V_{DD}$      | V                 |                                                                                 |
| On Resistance, $R_{ON}$                               | 300         |                   |                    | $\Omega$ typ      | $V_S = 0\text{ V}$ to $10\text{ V}$ , $I_S = -1\text{ mA}$ , see Figure 29      |
|                                                       | 475         | 567               | 625                | $\Omega$ max      | $V_{DD} = 10.8\text{ V}$ , $V_{SS} = 0\text{ V}$                                |
| On Resistance Match Between Channels, $\Delta R_{ON}$ | 5           |                   |                    | $\Omega$ typ      | $V_S = 0\text{ V}$ to $10\text{ V}$ , $I_S = -1\text{ mA}$                      |
|                                                       | 16          | 26                | 27                 | $\Omega$ max      |                                                                                 |
| On Resistance Flatness, $R_{FLAT}$ (On)               | 60          |                   |                    | $\Omega$ typ      | $V_S = 3\text{ V}$ , $6\text{ V}$ , $9\text{ V}$ ; $I_S = -1\text{ mA}$         |
| <b>LEAKAGE CURRENTS</b>                               |             |                   |                    |                   |                                                                                 |
| Source Off Leakage, $I_S$ (Off)                       | $\pm 0.02$  |                   |                    | nA typ            | $V_{DD} = 13.2\text{ V}$                                                        |
|                                                       | $\pm 0.1$   | $\pm 0.6$         | $\pm 1$            | nA max            | $V_S = 1\text{ V}/10\text{ V}$ , $V_D = 10\text{ V}/1\text{ V}$ , see Figure 30 |
| Drain Off Leakage, $I_D$ (Off)                        | $\pm 0.02$  |                   |                    | nA typ            | $V_S = 1\text{ V}/10\text{ V}$ , $V_D = 10\text{ V}/1\text{ V}$ , see Figure 30 |
| ADG1208                                               | $\pm 0.1$   | $\pm 0.6$         | $\pm 1$            | nA max            |                                                                                 |
| ADG1209                                               | $\pm 0.1$   | $\pm 0.6$         | $\pm 1$            | nA max            |                                                                                 |
| Channel On Leakage $I_D$ , $I_S$ (On)                 | $\pm 0.02$  |                   |                    | nA typ            | $V_S = V_D = 1\text{ V}$ or $10\text{ V}$ ; see Figure 31                       |
| ADG1208                                               | $\pm 0.2$   | $\pm 0.6$         | $\pm 1$            | nA max            |                                                                                 |
| ADG1209                                               | $\pm 0.2$   | $\pm 0.6$         | $\pm 1$            | nA max            |                                                                                 |
| <b>DIGITAL INPUTS</b>                                 |             |                   |                    |                   |                                                                                 |
| Input High Voltage, $V_{INH}$                         |             |                   | 2.0                | V min             |                                                                                 |
| Input Low Voltage, $V_{INL}$                          |             |                   | 0.8                | V max             |                                                                                 |
| Input Current, $I_{INL}$ or $I_{INH}$                 | $\pm 0.001$ |                   |                    | $\mu\text{A}$ max | $V_{IN} = V_{INL}$ or $V_{INH}$                                                 |
|                                                       |             |                   | $\pm 0.1$          | $\mu\text{A}$ max |                                                                                 |
| Digital Input Capacitance, $C_{IN}$                   | 3           |                   |                    | pF typ            |                                                                                 |
| <b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>            |             |                   |                    |                   |                                                                                 |
| Transition Time, $t_{TRANSITION}$                     | 100         |                   |                    | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$                                      |
|                                                       | 170         | 210               | 235                |                   | $V_S = 8\text{ V}$ , see Figure 32                                              |
| $t_{ON}$ (EN)                                         | 90          |                   |                    | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$                                      |
|                                                       | 110         | 140               | 160                |                   | $V_S = 8\text{ V}$ , see Figure 34                                              |
| $t_{OFF}$ (EN)                                        | 105         |                   |                    | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$                                      |
|                                                       | 130         | 155               | 175                |                   | $V_S = 8\text{ V}$ , see Figure 34                                              |
| Break-Before-Make Time Delay, $t_{BBM}$               | 45          |                   |                    | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$                                      |
|                                                       |             |                   | 20                 | ns min            | $V_{S1} = V_{S2} = 8\text{ V}$ , see Figure 33                                  |
| Charge Injection                                      | −0.2        |                   |                    | pC typ            | $V_S = 6\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ , see Figure 35    |
| Off Isolation                                         | −85         |                   |                    | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , see Figure 36   |
| Channel-to-Channel Crosstalk                          | −85         |                   |                    | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , see Figure 38   |
| −3 dB Bandwidth                                       | 450         |                   |                    | MHz typ           | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , see Figure 37                        |
| $C_S$ (Off)                                           | 1.2         |                   |                    | pF typ            | $f = 1\text{ MHz}$ , $V_S = 6\text{ V}$                                         |
|                                                       | 1.8         |                   |                    | pF max            | $f = 1\text{ MHz}$ , $V_S = 6\text{ V}$                                         |
| $C_D$ (Off) ADG1208                                   | 7.5         |                   |                    | pF typ            | $f = 1\text{ MHz}$ , $V_S = 6\text{ V}$                                         |
|                                                       | 9           |                   |                    | pF max            | $f = 1\text{ MHz}$ , $V_S = 6\text{ V}$                                         |
| $C_D$ (Off) ADG1209                                   | 4.5         |                   |                    | pF typ            | $f = 1\text{ MHz}$ , $V_S = 6\text{ V}$                                         |
|                                                       | 5.5         |                   |                    | pF max            | $f = 1\text{ MHz}$ , $V_S = 6\text{ V}$                                         |
| $C_D$ , $C_S$ (On) ADG1208                            | 9           |                   |                    | pF typ            | $f = 1\text{ MHz}$ , $V_S = 6\text{ V}$                                         |
|                                                       | 10.5        |                   |                    | pF max            | $f = 1\text{ MHz}$ , $V_S = 6\text{ V}$                                         |
| $C_D$ , $C_S$ (On) ADG1209                            | 6           |                   |                    | pF typ            | $f = 1\text{ MHz}$ , $V_S = 6\text{ V}$                                         |
|                                                       | 7.5         |                   |                    | pF max            | $f = 1\text{ MHz}$ , $V_S = 6\text{ V}$                                         |

# ADG1208/ADG1209

| Parameter          | +25°C | −40°C to<br>+85°C | −40°C to<br>+125°C | Unit             | Test Conditions/Comments                                     |
|--------------------|-------|-------------------|--------------------|------------------|--------------------------------------------------------------|
| POWER REQUIREMENTS |       |                   |                    |                  |                                                              |
| $I_{DD}$           | 0.002 |                   | 1.0                | μA typ<br>μA max | $V_{DD} = 13.2\text{ V}$<br>Digital inputs = 0 V or $V_{DD}$ |
| $I_{DD}$           | 220   |                   | 330                | μA typ<br>μA max | Digital inputs = 5 V                                         |
| $V_{DD}$           |       |                   | 5/16.5             | V min/max        | $V_{SS} = 0\text{ V}$ , GND = 0 V                            |

<sup>1</sup> Temperature range is as follows: Y version: −40°C to +125°C.

<sup>2</sup> Guaranteed by design, not subject to production test.

## ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ\text{C}$ , unless otherwise noted.

**Table 3.**

| Parameter                                                    | Rating                                                                                    |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| $V_{DD}$ to $V_{SS}$                                         | 35 V                                                                                      |
| $V_{DD}$ to GND                                              | −0.3 V to +25 V                                                                           |
| $V_{SS}$ to GND                                              | +0.3 V to −25 V                                                                           |
| Analog, Digital Inputs <sup>1</sup>                          | $V_{SS} - 0.3 \text{ V}$ to $V_{DD} + 0.3 \text{ V}$ or<br>30 mA (whichever occurs first) |
| Continuous Current, S or D                                   | 30 mA                                                                                     |
| Peak Current, S or D (Pulsed at<br>1 ms, 10% Duty Cycle max) | 100 mA                                                                                    |
| Operating Temperature Range                                  |                                                                                           |
| Industrial (Y Version)                                       | −40°C to +125°C                                                                           |
| Storage Temperature                                          | −65°C to +150°C                                                                           |
| Junction Temperature                                         | 150°C                                                                                     |
| TSSOP, $\theta_{JA}$ , Thermal Impedance                     | 112°C/W                                                                                   |
| LFCSP_VQ, $\theta_{JA}$ , Thermal Impedance                  | 30.4°C/W                                                                                  |
| Reflow Soldering Peak<br>Temperature (Pb-Free)               | 260(+0/−5)°C                                                                              |

<sup>1</sup> Overvoltages at A, EN, S, or D are clamped by internal diodes. Current should be limited to the maximum ratings given.

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



# ADG1208/ADG1209

## PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

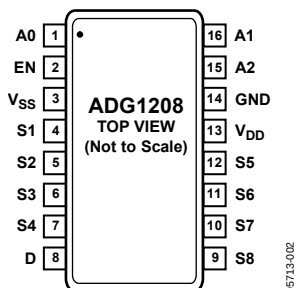


Figure 3. ADG1208 Pin Configuration (TSSOP)

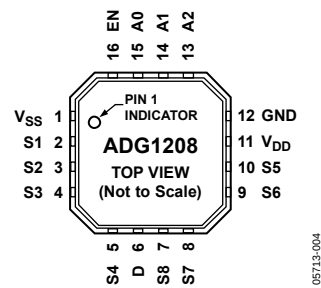


Figure 4. ADG1208 Pin Configuration (LFCSP\_VQ), Exposed Pad Tied to Substrate, V<sub>SS</sub>

Table 4. ADG1208 Pin Function Descriptions

| Pin Number |          |                 |                                                                                                                                                     |
|------------|----------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| TSSOP      | LFCSP_VQ | Mnemonic        | Description                                                                                                                                         |
| 1          | 15       | A0              | Logic Control Input.                                                                                                                                |
| 2          | 16       | EN              | Active High Digital Input. When low, the device is disabled and all switches are off. When high, A <sub>x</sub> logic inputs determine on switches. |
| 3          | 1        | V <sub>SS</sub> | Most Negative Power Supply Potential. In single supply applications, it can be connected to ground.                                                 |
| 4          | 2        | S1              | Source Terminal 1. Can be an input or an output.                                                                                                    |
| 5          | 3        | S2              | Source Terminal 2. Can be an input or an output.                                                                                                    |
| 6          | 4        | S3              | Source Terminal 3. Can be an input or an output.                                                                                                    |
| 7          | 5        | S4              | Source Terminal 4. Can be an input or an output.                                                                                                    |
| 8          | 6        | D               | Drain Terminal. Can be an input or an output.                                                                                                       |
| 9          | 7        | S8              | Source Terminal 8. Can be an input or an output.                                                                                                    |
| 10         | 8        | S7              | Source Terminal 7. Can be an input or an output.                                                                                                    |
| 11         | 9        | S6              | Source Terminal 6. Can be an input or an output.                                                                                                    |
| 12         | 10       | S5              | Source Terminal 5. Can be an input or an output.                                                                                                    |
| 13         | 11       | V <sub>DD</sub> | Most Positive Power Supply Potential.                                                                                                               |
| 14         | 12       | GND             | Ground (0 V) Reference.                                                                                                                             |
| 15         | 13       | A2              | Logic Control Input.                                                                                                                                |
| 16         | 14       | A1              | Logic Control Input.                                                                                                                                |

Table 5. ADG1208 Truth Table

| A2 | A1 | A0 | EN | ON SWITCH |
|----|----|----|----|-----------|
| X  | X  | X  | 0  | NONE      |
| 0  | 0  | 0  | 1  | 1         |
| 0  | 0  | 1  | 1  | 2         |
| 0  | 1  | 0  | 1  | 3         |
| 0  | 1  | 1  | 1  | 4         |
| 1  | 0  | 0  | 1  | 5         |
| 1  | 0  | 1  | 1  | 6         |
| 1  | 1  | 0  | 1  | 7         |
| 1  | 1  | 1  | 1  | 8         |

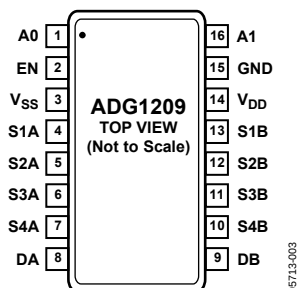


Figure 5. ADG1209 Pin Configuration (TSSOP)

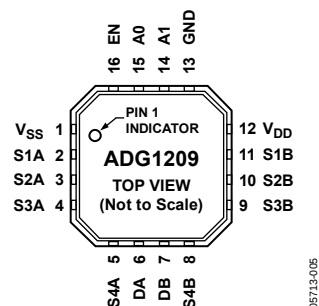


Figure 6. ADG1209 Pin Configurations (LFCSP\_VQ), Exposed Pad Tied to Substrate,  $V_{SS}$

Table 6. ADG1209 Pin Function Descriptions

| Pin Number |          | Mnemonic | Description                                                                                                                             |
|------------|----------|----------|-----------------------------------------------------------------------------------------------------------------------------------------|
| TSSOP      | LFCSP_VQ |          |                                                                                                                                         |
| 1          | 15       | A0       | Logic Control Input.                                                                                                                    |
| 2          | 16       | EN       | Active High Digital Input. When low, the device is disabled and all switches are off. When high, Ax logic inputs determine on switches. |
| 3          | 1        | $V_{SS}$ | Most Negative Power Supply Potential. In single supply applications, it can be connected to ground.                                     |
| 4          | 2        | S1A      | Source Terminal 1A. Can be an input or an output.                                                                                       |
| 5          | 3        | S2A      | Source Terminal 2A. Can be an input or an output.                                                                                       |
| 6          | 4        | S3A      | Source Terminal 3A. Can be an input or an output.                                                                                       |
| 7          | 5        | S4A      | Source Terminal 4A. Can be an input or an output.                                                                                       |
| 8          | 6        | DA       | Drain Terminal A. Can be an input or an output.                                                                                         |
| 9          | 7        | DB       | Drain Terminal B. Can be an input or an output.                                                                                         |
| 10         | 8        | S4B      | Source Terminal 4B. Can be an input or an output.                                                                                       |
| 11         | 9        | S3B      | Source Terminal 3B. Can be an input or an output.                                                                                       |
| 12         | 10       | S2B      | Source Terminal 2B. Can be an input or an output.                                                                                       |
| 13         | 11       | S1B      | Source Terminal 1B. Can be an input or an output.                                                                                       |
| 14         | 12       | $V_{DD}$ | Most Positive Power Supply Potential.                                                                                                   |
| 15         | 13       | GND      | Ground (0 V) Reference.                                                                                                                 |
| 16         | 14       | A1       | Logic Control Input.                                                                                                                    |

Table 7. ADG1209 Truth Table

| A1 | A0 | EN | ON SWITCH PAIR |
|----|----|----|----------------|
| X  | X  | 0  | NONE           |
| 0  | 0  | 1  | 1              |
| 0  | 1  | 1  | 2              |
| 1  | 0  | 1  | 3              |
| 1  | 1  | 1  | 4              |

## TYPICAL PERFORMANCE CHARACTERISTICS

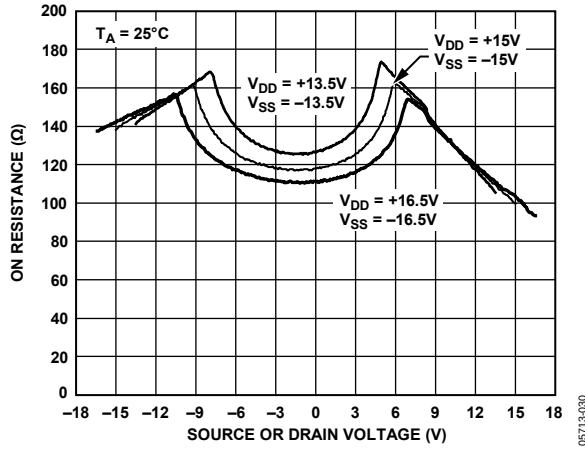


Figure 7. On Resistance as a Function of  $V_D$  ( $V_S$ ) for Dual Supply

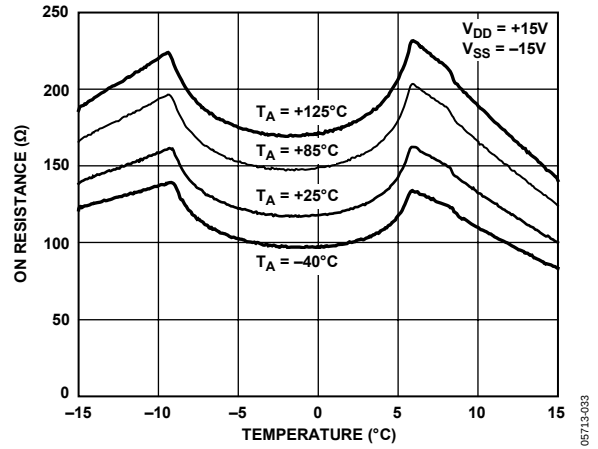


Figure 10. On Resistance as a Function of  $V_D$  ( $V_S$ ) for Different Temperatures, Dual Supply

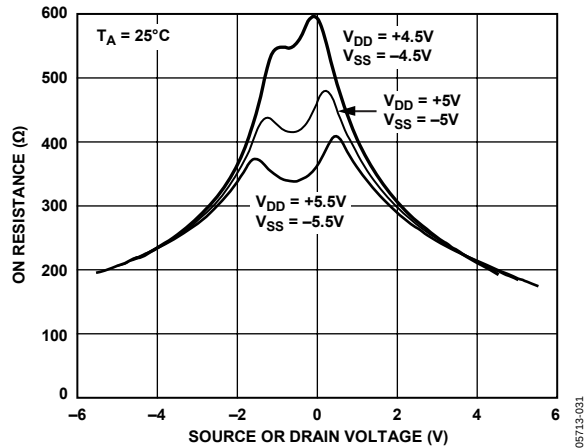


Figure 8. On Resistance as a Function of  $V_D$  ( $V_S$ ) for Dual Supply

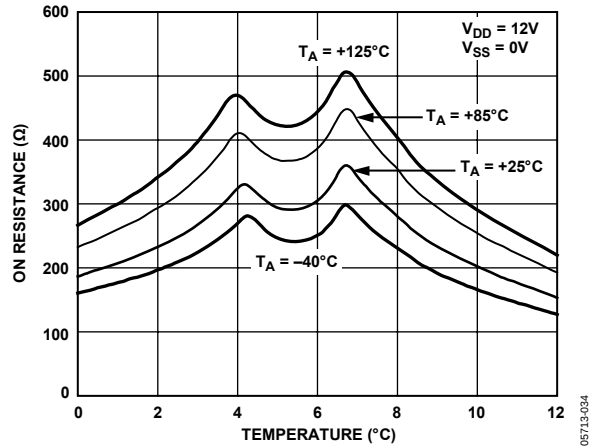


Figure 11. On Resistance as a Function of  $V_D$  ( $V_S$ ) for Different Temperatures, Single Supply

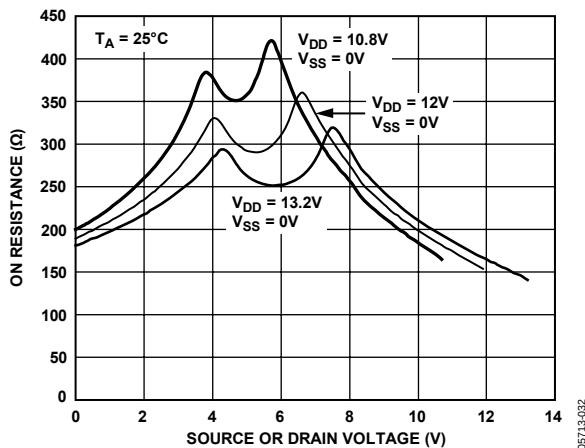


Figure 9. On Resistance as a Function of  $V_D$  ( $V_S$ ) for Single Supply

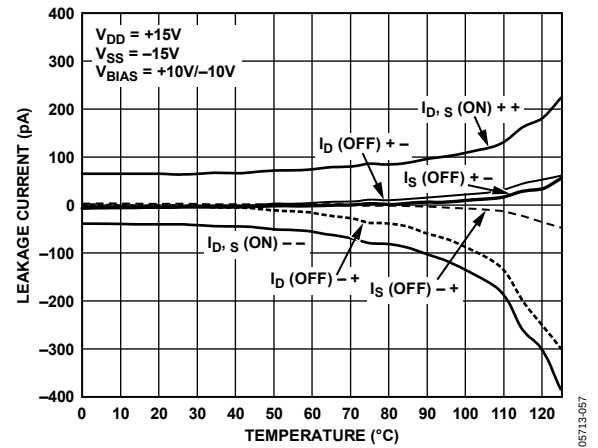


Figure 12. ADG1208 Leakage Currents as a Function of Temperature, Dual Supply

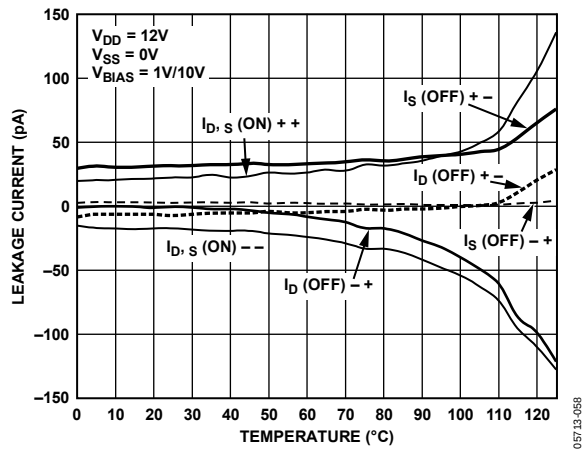


Figure 13. ADG1208 Leakage Currents as a Function of Temperature, Single Supply

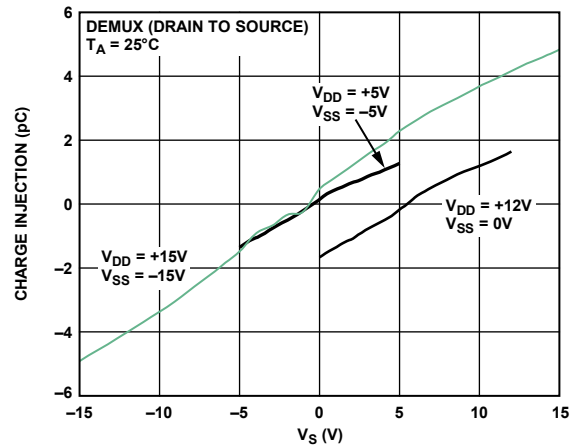


Figure 16. Drain-to-Source Charge Injection vs. Source Voltage

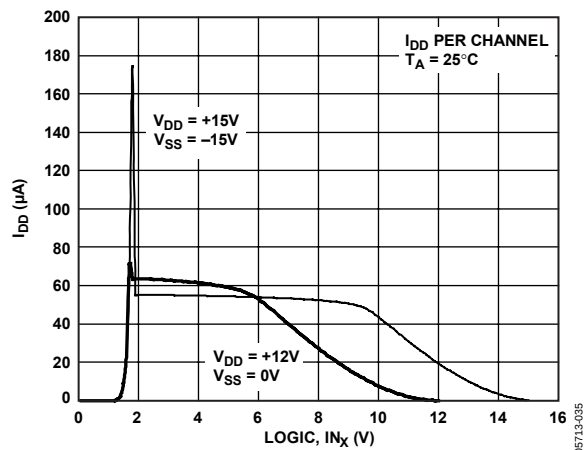


Figure 14.  $I_{DD}$  vs. Logic Level

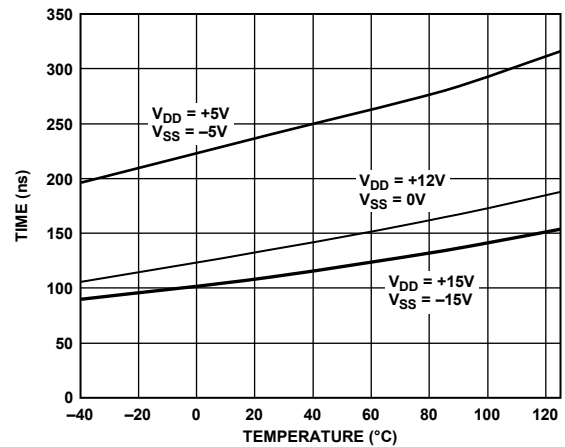


Figure 17.  $t_{ON}/t_{OFF}$  Times vs. Temperature

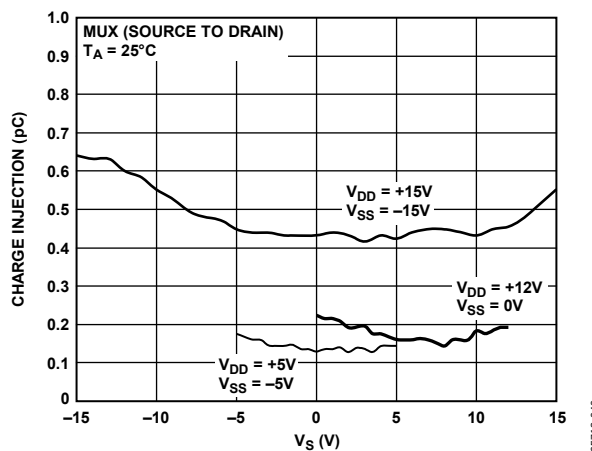


Figure 15. Source-to-Drain Charge Injection vs. Source Voltage

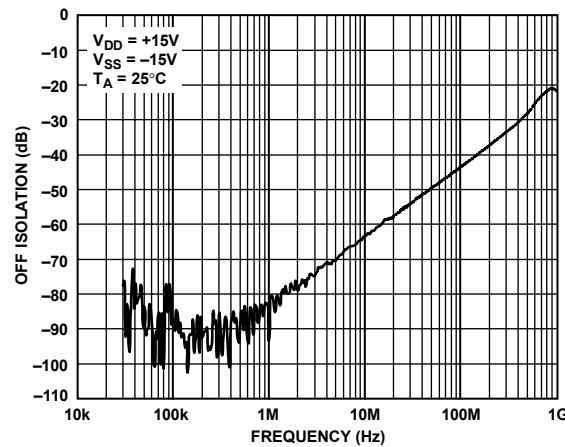


Figure 18. Off Isolation vs. Frequency

# ADG1208/ADG1209

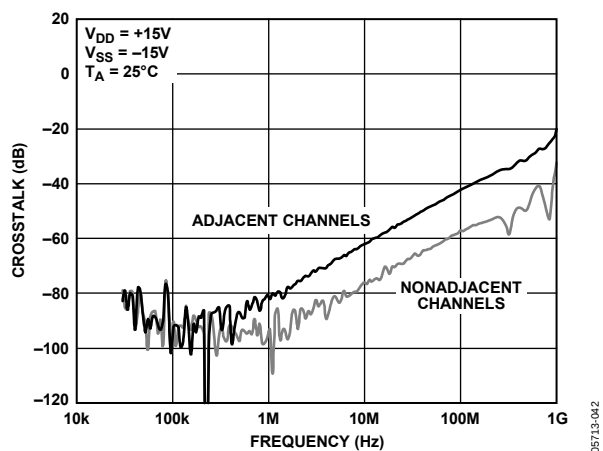


Figure 19. ADG1208 Crosstalk vs. Frequency

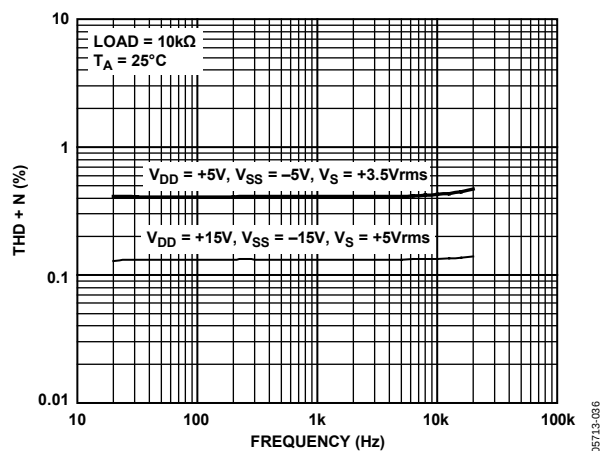


Figure 22. THD + N vs. Frequency

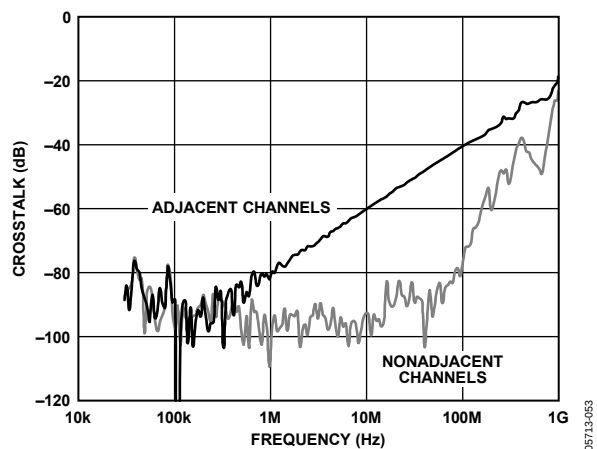


Figure 20. ADG1209 Crosstalk vs. Frequency

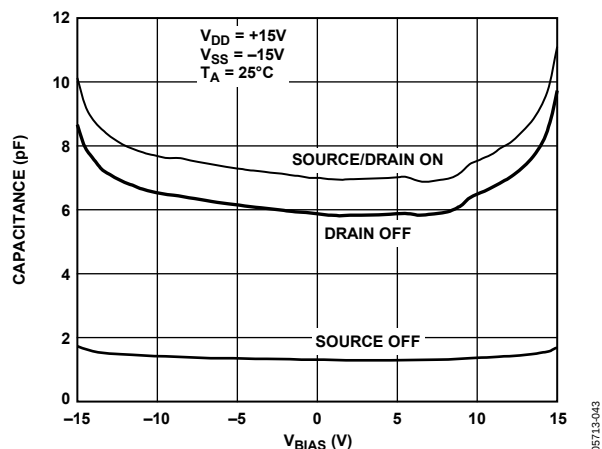


Figure 23. ADG1208 Capacitance vs. Source Voltage,  $\pm 15$  V Dual Supply

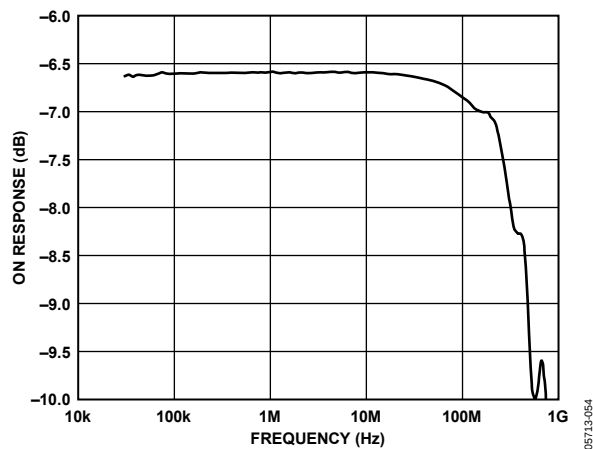


Figure 21. On Response vs. Frequency

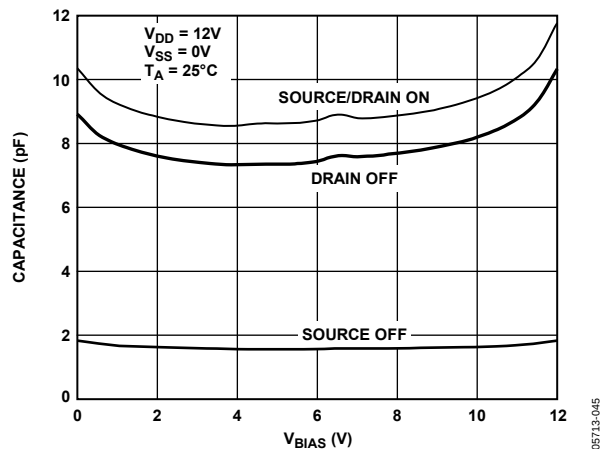


Figure 24. ADG1208 Capacitance vs. Source Voltage, 12 V Single Supply

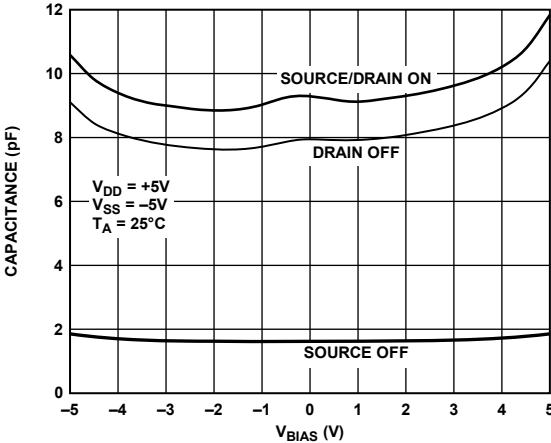


Figure 25. ADG1208 Capacitance vs. Source Voltage,  $\pm 5$  V Dual Supply

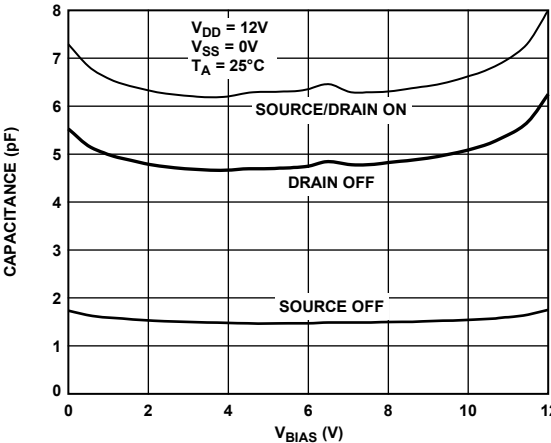


Figure 27. ADG1209 Capacitance vs. Source Voltage, 12 V Single Supply

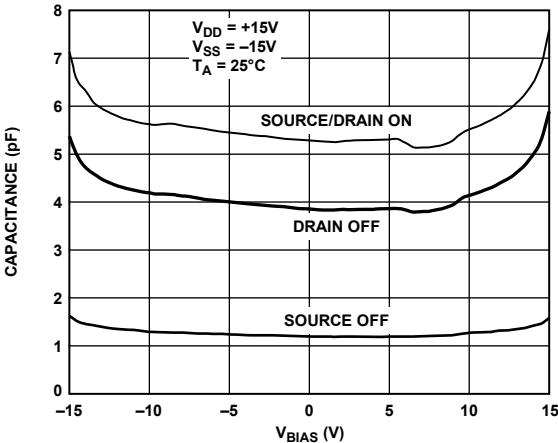


Figure 26. ADG1209 Capacitance vs. Source Voltage,  $\pm 15$  V Dual Supply

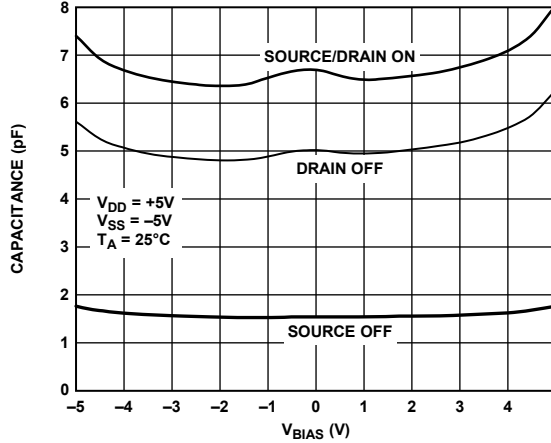


Figure 28. ADG1209 Capacitance vs. Source Voltage,  $\pm 5$  V Dual Supply

## TERMINOLOGY

### **R<sub>ON</sub>**

Ohmic resistance between D and S.

### **ΔR<sub>ON</sub>**

Difference between the R<sub>ON</sub> of any two channels.

### **I<sub>S</sub> (Off)**

Source leakage current when the switch is off.

### **I<sub>D</sub> (Off)**

Drain leakage current when the switch is off.

### **I<sub>D</sub>, I<sub>S</sub> (On)**

Channel leakage current when the switch is on.

### **V<sub>D</sub> (V<sub>S</sub>)**

Analog voltage on terminals D, S.

### **C<sub>S</sub> (Off)**

Channel input capacitance for off condition.

### **C<sub>D</sub> (Off)**

Channel output capacitance for off condition.

### **C<sub>D</sub>, C<sub>S</sub> (On)**

On switch capacitance.

### **C<sub>IN</sub>**

Digital input capacitance.

### **t<sub>ON</sub> (EN)**

Delay time between the 50% and 90% points of the digital input and switch on condition.

### **t<sub>OFF</sub> (EN)**

Delay time between the 50% and 90% points of the digital input and switch off condition.

### **t<sub>TRANSITION</sub>**

Delay time between the 50% and 90% points of the digital inputs and the switch on condition when switching from one address state to another.

### **T<sub>BBM</sub>**

Off time measured between the 80% point of both switches when switching from one address state to another.

### **V<sub>INL</sub>**

Maximum input voltage for Logic 0.

### **V<sub>INH</sub>**

Minimum input voltage for Logic 1.

### **I<sub>INL</sub> (I<sub>INH</sub>)**

Input current of the digital input.

### **I<sub>DD</sub>**

Positive supply current.

### **I<sub>SS</sub>**

Negative supply current.

### **Off Isolation**

A measure of unwanted signal coupling through an off channel.

### **Charge Injection**

A measure of the glitch impulse transferred from the digital input to the analog output during switching.

### **Bandwidth**

The frequency at which the output is attenuated by 3 dB.

### **On Response**

The frequency response of the on switch.

### **THD + N**

The ratio of the harmonic amplitude plus noise of the signal to the fundamental.

## TEST CIRCUITS

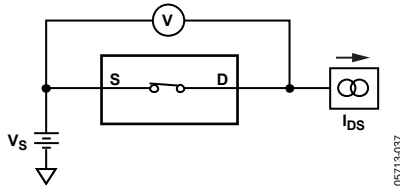


Figure 29. On Resistance

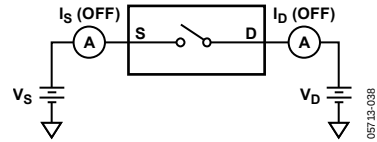


Figure 30. Off Leakage

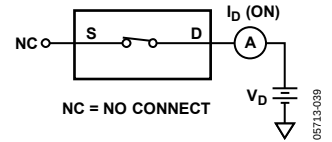


Figure 31. On Leakage

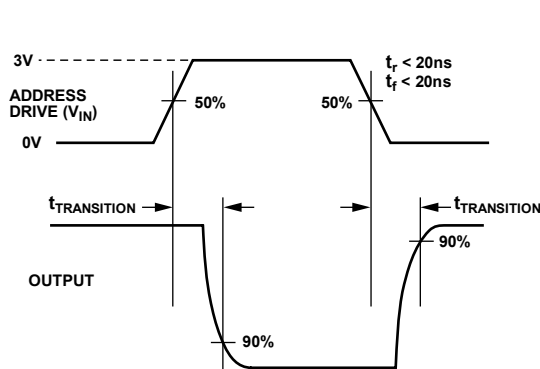
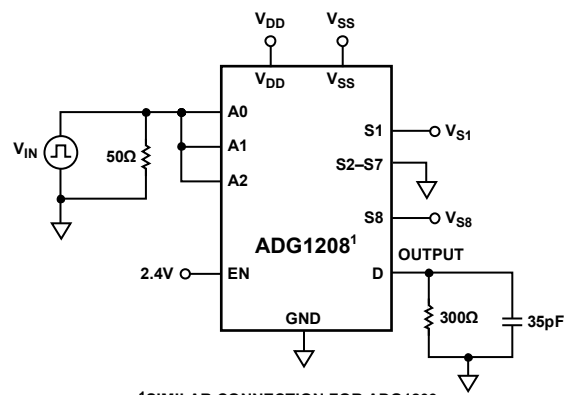


Figure 32. Address to Output Switching Times,  $t_{\text{TRANSITION}}$



<sup>1</sup>SIMILAR CONNECTION FOR ADG1209.

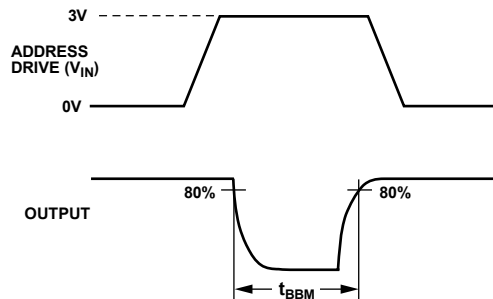
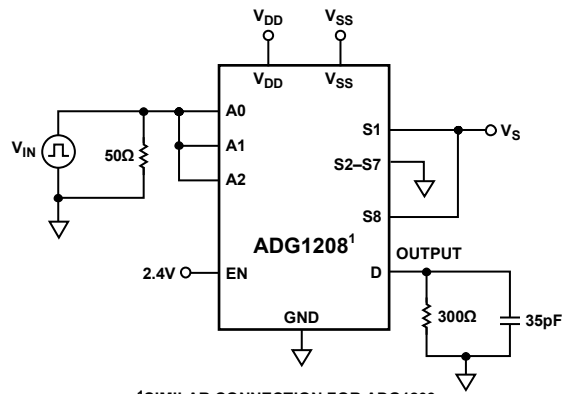


Figure 33. Break-Before-Make Delay,  $t_{\text{BBM}}$



<sup>1</sup>SIMILAR CONNECTION FOR ADG1209.

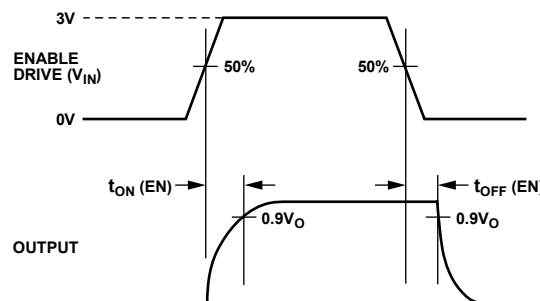
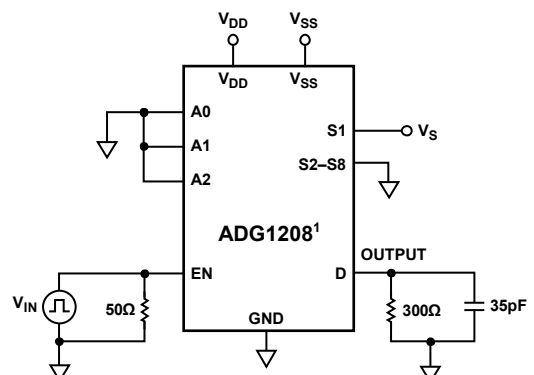


Figure 34. Enable Delay,  $t_{\text{ON}}(\text{EN})$ ,  $t_{\text{OFF}}(\text{EN})$



<sup>1</sup>SIMILAR CONNECTION FOR ADG1209.

# ADG1208/ADG1209

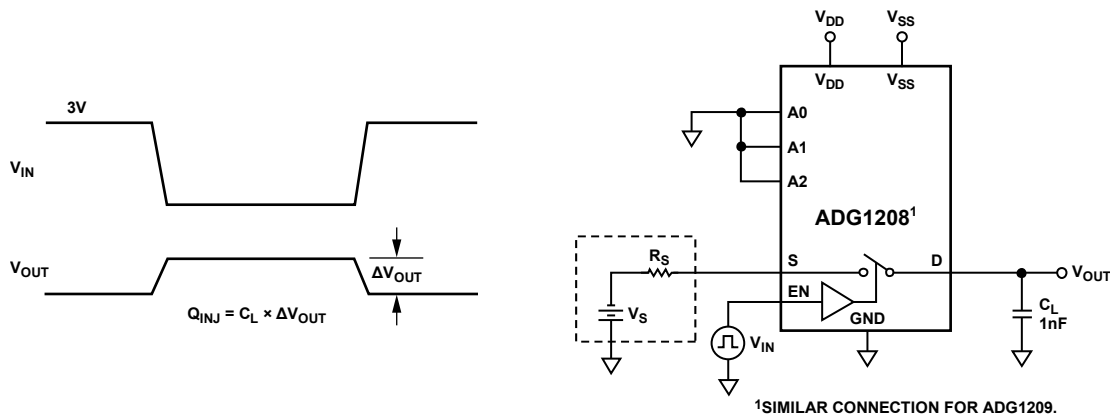


Figure 35. Charge Injection

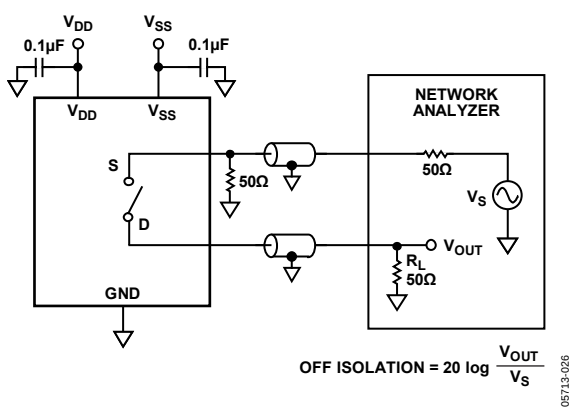


Figure 36. Off Isolation

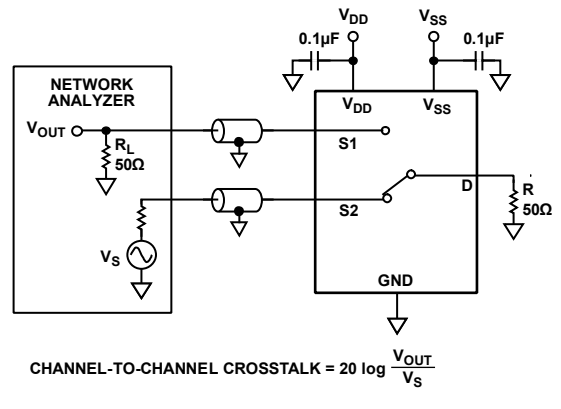


Figure 38. Channel-to-Channel Crosstalk

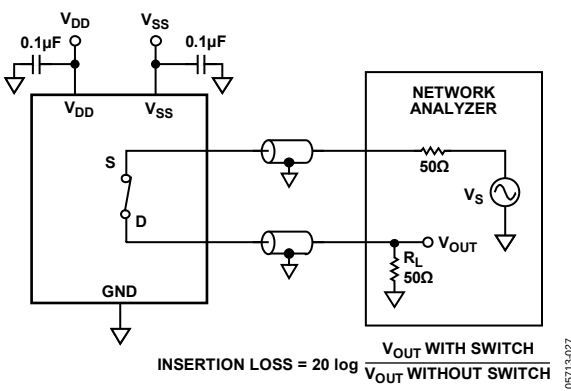


Figure 37. Bandwidth

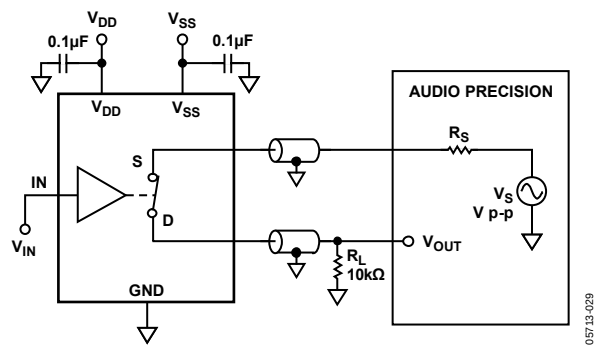
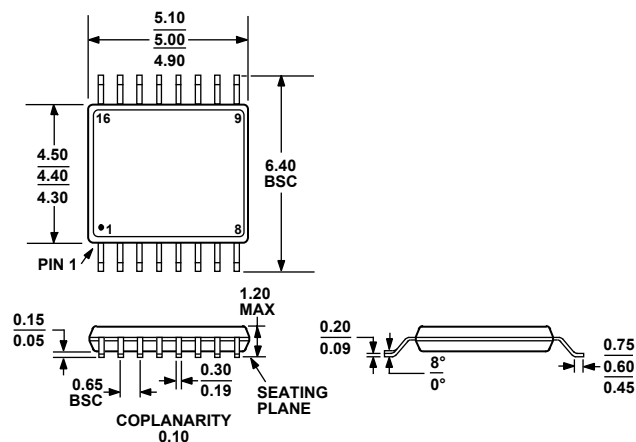


Figure 39. THD + Noise

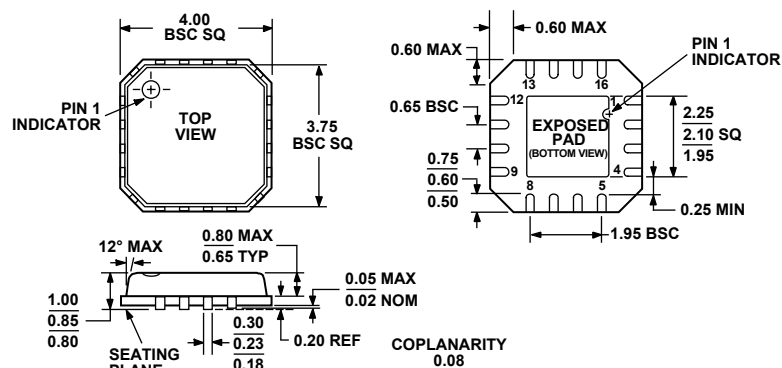
## OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AB

Figure 40. 16-Lead Thin Shrink Small Outline Package [TSSOP]  
(RU-16)

Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-220-VGGC

Figure 41. 16-Lead Lead Frame Chip Scale Package [LFCSP\_VQ]  
4 mm × 4 mm Body, Very Thin Quad  
(CP-16-4)

Dimensions shown in millimeters

## ORDERING GUIDE

| Model                          | Temperature Range | Package Description                               | Package Option |
|--------------------------------|-------------------|---------------------------------------------------|----------------|
| ADG1208YRUZ <sup>1</sup>       | −40°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |
| ADG1208YRUZ-REEL7 <sup>1</sup> | −40°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |
| ADG1208YCPZ-REEL <sup>1</sup>  | −40°C to +125°C   | 16-Lead Lead Frame Chip Scale Package [LFCSP_VQ]  | CP-16-4        |
| ADG1208YCPZ-REEL7 <sup>1</sup> | −40°C to +125°C   | 16-Lead Lead Frame Chip Scale Package [LFCSP_VQ]  | CP-16-4        |
| ADG1209YRUZ <sup>1</sup>       | −40°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |
| ADG1209YRUZ-REEL7 <sup>1</sup> | −40°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |
| ADG1209YCPZ-REEL <sup>1</sup>  | −40°C to +125°C   | 16-Lead Lead Frame Chip Scale Package [LFCSP_VQ]  | CP-16-4        |
| ADG1209YCPZ-REEL7 <sup>1</sup> | −40°C to +125°C   | 16-Lead Lead Frame Chip Scale Package [LFCSP_VQ]  | CP-16-4        |

<sup>1</sup> Z = Pb-free part.

|                        |
|------------------------|
| <b>ADG1208/ADG1209</b> |
|------------------------|

## **NOTES**

**NOTES**

**ADG1208/ADG1209**

## **NOTES**