

## ADG1408-EP/ADG1409-EP

### FEATURES

**4.7  $\Omega$  maximum on resistance @ 25°C**  
**0.5  $\Omega$  on resistance flatness**  
**Up to 190 mA continuous current**  
**Fully specified at  $\pm 15$  V/ $+12$  V/ $\pm 5$  V**  
**3 V logic-compatible inputs**  
**Rail-to-rail operation**  
**Break-before-make switching action**  
**16-lead TSSOP**

### ENHANCED PRODUCT FEATURES

**Supports defense and aerospace applications**  
**(AQEC standard)**  
**Military temperature range:  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$**   
**Controlled manufacturing baseline**  
**One assembly and test site**  
**One fabrication site**  
**Enhanced product change notification**  
**Qualification data available on request**

### GENERAL DESCRIPTION

The ADG1408-EP/ADG1409-EP are monolithic *i*CMOS® analog multiplexers comprising eight single channels and four differential channels, respectively. The ADG1408-EP switches one of eight inputs to a common output, as determined by the 3-bit binary address lines, A0, A1, and A2. The ADG1409-EP 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.

The *i*CMOS (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, *i*CMOS components can tolerate high supply voltages while providing increased performance, dramatically lower power consumption, and reduced package size.

### FUNCTIONAL BLOCK DIAGRAM

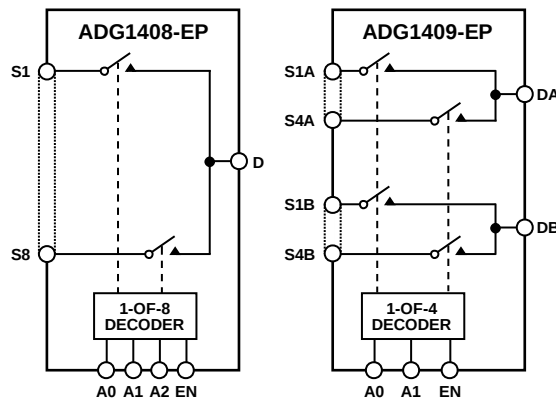


Figure 1.

The ultralow on resistance and on resistance flatness of these switches make them ideal solutions for data acquisition and gain switching applications where low distortion is critical. *i*CMOS construction ensures ultralow power dissipation, making the parts ideally suited for portable and battery-powered instruments.

Full details about this enhanced product are available in the ADG1408/ADG1409 data sheet, which should be consulted in conjunction with this data sheet.

### PRODUCT HIGHLIGHTS

1. 4  $\Omega$  on resistance
2. 0.5  $\Omega$  on resistance flatness
3. 3 V logic-compatible digital input,  $V_{INH} = 2.0$  V,  $V_{INL} = 0.8$  V
4. 16-lead TSSOP package

#### Rev. 0

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REVISION HISTORY

3/11—Revision 0: Initial Version

# SPECIFICATIONS

## 15 V DUAL SUPPLY

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

Table 1.

| Parameter                                                | +25°C       | –55°C to +125°C      | Unit              | Test Conditions/Comments                                                              |
|----------------------------------------------------------|-------------|----------------------|-------------------|---------------------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                     |             |                      |                   |                                                                                       |
| Analog Signal Range                                      |             | $V_{SS}$ to $V_{DD}$ | V                 |                                                                                       |
| On Resistance ( $R_{ON}$ )                               | 4           |                      | $\Omega$ typ      | $V_S = \pm 10\text{ V}$ , $I_S = -10\text{ mA}$ ; see Figure 12                       |
|                                                          | 4.7         | 6.7                  | $\Omega$ max      | $V_{DD} = +13.5\text{ V}$ , $V_{SS} = -13.5\text{ V}$                                 |
| On Resistance Match Between Channels ( $\Delta R_{ON}$ ) | 0.2         |                      | $\Omega$ typ      | $V_S = \pm 10\text{ V}$ , $I_S = -10\text{ mA}$                                       |
|                                                          | 0.78        | 1.1                  | $\Omega$ max      |                                                                                       |
| On Resistance Flatness ( $R_{FLAT(ON)}$ )                | 0.5         |                      | $\Omega$ typ      | $V_S = \pm 10\text{ V}$ , $I_S = -10\text{ mA}$                                       |
|                                                          | 0.72        | 0.92                 | $\Omega$ max      |                                                                                       |
| <b>LEAKAGE CURRENTS</b>                                  |             |                      |                   |                                                                                       |
| Source Off Leakage, $I_S$ (Off)                          | $\pm 0.04$  |                      | nA typ            | $V_{DD} = +16.5\text{ V}$ , $V_{SS} = -16.5\text{ V}$                                 |
|                                                          | $\pm 0.2$   | $\pm 5$              | nA max            | $V_S = \pm 10\text{ V}$ , $V_D = \mp 10\text{ V}$ ; see Figure 13                     |
| Drain Off Leakage, $I_D$ (Off)                           | $\pm 0.04$  |                      | nA typ            | $V_S = \pm 10\text{ V}$ , $V_D = \mp 10\text{ V}$ ; see Figure 13                     |
|                                                          | $\pm 0.45$  | $\pm 30$             | nA max            |                                                                                       |
| Channel On Leakage, $I_D$ , $I_S$ (On)                   | $\pm 0.1$   |                      | nA typ            | $V_S = V_D = \pm 10\text{ V}$ ; see Figure 14                                         |
|                                                          | $\pm 1.5$   | $\pm 30$             | 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                                            | $\pm 0.005$ |                      | $\mu\text{A}$ typ | $V_{IN} = V_{GND}$ or $V_{DD}$                                                        |
|                                                          |             | $\pm 0.1$            | $\mu\text{A}$ max |                                                                                       |
| Digital Input Capacitance, $C_{IN}$                      | 4           |                      | pF typ            |                                                                                       |
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>               |             |                      |                   |                                                                                       |
| Transition Time, $t_{TRANSITION}$                        | 140         |                      | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                            |
|                                                          | 170         | 240                  | ns max            | $V_S = 10\text{ V}$ , see Figure 15                                                   |
| Break-Before-Make Time Delay, $t_{BBM}$                  | 50          |                      | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                            |
|                                                          |             | 19                   | ns min            | $V_{S1} = V_{S2} = 10\text{ V}$ ; see Figure 16                                       |
| $t_{ON}$ (EN)                                            | 100         |                      | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                            |
|                                                          | 120         | 165                  | ns max            | $V_S = 10\text{ V}$ ; see Figure 17                                                   |
| $t_{OFF}$ (EN)                                           | 100         |                      | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                            |
|                                                          | 120         | 170                  | ns max            | $V_S = 10\text{ V}$ ; see Figure 17                                                   |
| Charge Injection                                         | –50         |                      | pC typ            | $V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 18          |
| Off Isolation                                            | –70         |                      | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 19         |
| Channel-to-Channel Crosstalk                             | –70         |                      | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 20         |
| Total Harmonic Distortion, THD + N                       | 0.025       |                      | % typ             | $R_L = 110\ \Omega$ , 15 V p-p, $f = 20\text{ Hz}$ to $20\text{ kHz}$ ; see Figure 22 |
| –3 dB Bandwidth                                          |             |                      |                   | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 21                              |
| ADG1408-EP                                               | 60          |                      | MHz typ           |                                                                                       |
| ADG1409-EP                                               | 115         |                      | MHz typ           |                                                                                       |
| Insertion Loss                                           | 0.24        |                      | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 21         |
| $C_S$ (Off)                                              | 14          |                      | pF typ            | $f = 1\text{ MHz}$                                                                    |
| $C_D$ (Off)                                              |             |                      |                   |                                                                                       |
| ADG1408-EP                                               | 80          |                      | pF typ            | $f = 1\text{ MHz}$                                                                    |
| ADG1409-EP                                               | 40          |                      | pF typ            | $f = 1\text{ MHz}$                                                                    |
| $C_D$ , $C_S$ (On)                                       |             |                      |                   |                                                                                       |
| ADG1408-EP                                               | 135         |                      | pF typ            | $f = 1\text{ MHz}$                                                                    |
| ADG1409-EP                                               | 90          |                      | pF typ            | $f = 1\text{ MHz}$                                                                    |

# ADG1408-EP/ADG1409-EP

| Parameter          | +25°C | −55°C to<br>+125°C | Unit                                   | Test Conditions/Comments                              |
|--------------------|-------|--------------------|----------------------------------------|-------------------------------------------------------|
| POWER REQUIREMENTS |       |                    |                                        | $V_{DD} = +16.5\text{ V}$ , $V_{SS} = -16.5\text{ V}$ |
| $I_{DD}$           | 0.002 | 1                  | $\mu\text{A typ}$<br>$\mu\text{A max}$ | Digital inputs = 0 V or $V_{DD}$                      |
|                    | 220   | 420                | $\mu\text{A typ}$<br>$\mu\text{A max}$ | Digital inputs = 5 V                                  |
| $I_{SS}$           | 0.002 | 1                  | $\mu\text{A typ}$<br>$\mu\text{A max}$ | Digital inputs = 0 V, 5 V or $V_{DD}$                 |
| $V_{DD}/V_{SS}$    |       | $\pm 4.5/\pm 16.5$ | V min/max                              |                                                       |

<sup>1</sup> Guaranteed by design, not subject to production test.

**12 V SINGLE SUPPLY**

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

**Table 2.**

| Parameter                                  | +25°C       | –55°C to +125°C | Unit              | Test Conditions/Comments                                                        |
|--------------------------------------------|-------------|-----------------|-------------------|---------------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                       |             |                 |                   |                                                                                 |
| Analog Signal Range                        |             | 0 to $V_{DD}$   | V                 |                                                                                 |
| On Resistance ( $R_{ON}$ )                 | 6           |                 | $\Omega$ typ      | $V_S = 0\text{ V}$ to $10\text{ V}$ , $I_S = -10\text{ mA}$ ; see Figure 12     |
|                                            | 8           | 11.2            | $\Omega$ max      | $V_{DD} = 10.8\text{ V}$ , $V_{SS} = 0\text{ V}$                                |
| On Resistance Match                        | 0.2         |                 | $\Omega$ typ      | $V_S = 0\text{ V}$ to $10\text{ V}$ , $I_S = -10\text{ mA}$                     |
| Between Channels ( $\Delta R_{ON}$ )       | 0.82        | 1.1             | $\Omega$ max      |                                                                                 |
| On Resistance Flatness ( $R_{FLAT(ON)}$ )  | 1.5         |                 | $\Omega$ typ      | $V_S = 0\text{ V}$ to $10\text{ V}$ , $I_S = -10\text{ mA}$                     |
|                                            | 2.5         | 2.8             | $\Omega$ max      |                                                                                 |
| <b>LEAKAGE CURRENTS</b>                    |             |                 |                   |                                                                                 |
| Source Off Leakage, $I_S$ (Off)            | $\pm 0.04$  |                 | nA typ            | $V_{DD} = 13.2\text{ V}$                                                        |
|                                            | $\pm 0.2$   | $\pm 5$         | nA max            | $V_S = 1\text{ V}/10\text{ V}$ , $V_D = 10\text{ V}/1\text{ V}$ ; see Figure 13 |
| Drain Off Leakage, $I_D$ (Off)             | $\pm 0.04$  |                 | nA typ            | $V_S = 1\text{ V}/10\text{ V}$ , $V_D = 10\text{ V}/1\text{ V}$ ; see Figure 13 |
|                                            | $\pm 0.45$  | $\pm 37$        | nA max            |                                                                                 |
| Channel On Leakage, $I_D$ , $I_S$ (On)     | $\pm 0.06$  |                 | nA typ            | $V_S = V_D = 1\text{ V}$ or $10\text{ V}$ ; see Figure 14                       |
|                                            | $\pm 0.44$  | $\pm 32$        | 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                              | $\pm 0.005$ |                 | $\mu\text{A}$ typ | $V_{IN} = V_{GND}$ or $V_{DD}$                                                  |
|                                            |             | $\pm 0.1$       | $\mu\text{A}$ max |                                                                                 |
| Digital Input Capacitance, $C_{IN}$        | 5           |                 | pF typ            |                                                                                 |
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b> |             |                 |                   |                                                                                 |
| Transition Time, $t_{TRANSITION}$          | 200         |                 | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                      |
|                                            | 260         | 380             | ns max            | $V_S = 8\text{ V}$ ; see Figure 15                                              |
| Break-Before-Make Time Delay, $t_{BBM}$    | 90          |                 | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                      |
|                                            |             | 40              | ns min            | $V_{S1} = V_{S2} = 8\text{ V}$ ; see Figure 16                                  |
| $t_{ON}$ (EN)                              | 160         |                 | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                      |
|                                            | 210         | 285             | ns max            | $V_S = 8\text{ V}$ ; see Figure 17                                              |
| $t_{OFF}$ (EN)                             | 115         |                 | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                      |
|                                            | 145         | 200             | ns max            | $V_S = 8\text{ V}$ ; see Figure 17                                              |
| Charge Injection                           | –12         |                 | pC typ            | $V_S = 6\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 18    |
| Off Isolation                              | –70         |                 | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 19   |
| Channel-to-Channel Crosstalk               | –70         |                 | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 20   |
| –3 dB Bandwidth                            |             |                 |                   | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 21                        |
| ADG1408-EP                                 | 36          |                 | MHz typ           |                                                                                 |
| ADG1409-EP                                 | 72          |                 | MHz typ           |                                                                                 |
| Insertion Loss                             | 0.5         |                 | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 21   |
| $C_S$ (Off)                                | 25          |                 | pF typ            | $f = 1\text{ MHz}$                                                              |
| $C_D$ (Off)                                |             |                 |                   |                                                                                 |
| ADG1408-EP                                 | 165         |                 | pF typ            | $f = 1\text{ MHz}$                                                              |
| ADG1409-EP                                 | 80          |                 | pF typ            | $f = 1\text{ MHz}$                                                              |
| $C_D$ , $C_S$ (On)                         |             |                 |                   |                                                                                 |
| ADG1408-EP                                 | 200         |                 | pF typ            | $f = 1\text{ MHz}$                                                              |
| ADG1409-EP                                 | 120         |                 | pF typ            | $f = 1\text{ MHz}$                                                              |

# ADG1408-EP/ADG1409-EP

| Parameter          | +25°C | –55°C to<br>+125°C | Unit              | Test Conditions/Comments          |
|--------------------|-------|--------------------|-------------------|-----------------------------------|
| POWER REQUIREMENTS |       |                    |                   | $V_{DD} = 13.2\text{ V}$          |
| $I_{DD}$           | 0.002 | 1                  | $\mu\text{A typ}$ | Digital inputs = 0 V or $V_{DD}$  |
|                    | 220   | 420                | $\mu\text{A max}$ | Digital inputs = 5 V              |
| $V_{DD}$           |       | 5/16.5             | $\mu\text{A typ}$ |                                   |
|                    |       |                    | $\mu\text{A max}$ |                                   |
|                    |       |                    | V min/max         | $V_{SS} = 0\text{ V}$ , GND = 0 V |

<sup>1</sup> Guaranteed by design, not subject to production test.

**5 V DUAL SUPPLY**

$V_{DD} = +5\text{ V} \pm 10\%$ ,  $V_{SS} = -5\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ , unless otherwise noted.

**Table 3.**

| Parameter                                                | +25°C       | –55°C to +125°C      | Unit              | Test Conditions/Comments                                                                      |
|----------------------------------------------------------|-------------|----------------------|-------------------|-----------------------------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                     |             |                      |                   |                                                                                               |
| Analog Signal Range                                      |             | $V_{SS}$ to $V_{DD}$ | V                 |                                                                                               |
| On Resistance ( $R_{ON}$ )                               | 7           |                      | $\Omega$ typ      | $V_S = \pm 4.5\text{ V}$ , $I_S = -10\text{ mA}$ ; see Figure 12                              |
|                                                          | 9           | 12                   | $\Omega$ max      | $V_{DD} = +4.5\text{ V}$ , $V_{SS} = -4.5\text{ V}$                                           |
| On Resistance Match Between Channels ( $\Delta R_{ON}$ ) | 0.3         |                      | $\Omega$ typ      | $V_S = \pm 4.5\text{ V}$ , $I_S = -10\text{ mA}$                                              |
|                                                          | 0.78        | 1.1                  | $\Omega$ max      |                                                                                               |
| On Resistance Flatness ( $R_{FLAT(ON)}$ )                | 1.5         |                      | $\Omega$ typ      | $V_S = \pm 4.5\text{ V}$ ; $I_S = -10\text{ mA}$                                              |
|                                                          | 2.5         | 3                    | $\Omega$ max      |                                                                                               |
| <b>LEAKAGE CURRENTS</b>                                  |             |                      |                   |                                                                                               |
| Source Off Leakage, $I_S$ (Off)                          | $\pm 0.02$  |                      | nA typ            | $V_{DD} = +5.5\text{ V}$ , $V_{SS} = -5.5\text{ V}$                                           |
|                                                          | $\pm 0.2$   | $\pm 5$              | nA max            | $V_S = \pm 4.5\text{ V}$ , $V_D = \mp 4.5\text{ V}$ ; see Figure 13                           |
| Drain Off Leakage, $I_D$ (Off)                           | $\pm 0.02$  |                      | nA typ            | $V_S = \pm 4.5\text{ V}$ , $V_D = \mp 4.5\text{ V}$ ; see Figure 13                           |
|                                                          | $\pm 0.45$  | $\pm 20$             | nA max            |                                                                                               |
| Channel On Leakage, $I_D$ , $I_S$ (On)                   | $\pm 0.04$  |                      | nA typ            | $V_S = V_D = \pm 4.5\text{ V}$ ; see Figure 14                                                |
|                                                          | $\pm 0.3$   | $\pm 22$             | 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                                            | $\pm 0.005$ |                      | $\mu\text{A}$ typ | $V_{IN} = V_{GND}$ or $V_{DD}$                                                                |
|                                                          |             | $\pm 0.1$            | $\mu\text{A}$ max |                                                                                               |
| Digital Input Capacitance, $C_{IN}$                      | 5           |                      | pF typ            |                                                                                               |
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>               |             |                      |                   |                                                                                               |
| Transition Time, $t_{TRANSITION}$                        | 330         |                      | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                                    |
|                                                          | 440         | 550                  | ns max            | $V_S = 5\text{ V}$ ; see Figure 15                                                            |
| Break-Before-Make Time Delay, $t_{BBM}$                  | 100         |                      | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                                    |
|                                                          |             | 45                   | ns min            | $V_{S1} = V_{S2} = 5\text{ V}$ ; see Figure 16                                                |
| $t_{ON}$ (EN)                                            | 245         |                      | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                                    |
|                                                          | 330         | 440                  | ns max            | $V_S = 5\text{ V}$ ; see Figure 17                                                            |
| $t_{OFF}$ (EN)                                           | 215         |                      | ns typ            | $R_L = 100\ \Omega$ , $C_L = 35\text{ pF}$                                                    |
|                                                          | 285         | 370                  | ns max            | $V_S = 5\text{ V}$ ; see Figure 17                                                            |
| Charge Injection                                         | –10         |                      | pC typ            | $V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 18                  |
| Off Isolation                                            | –70         |                      | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 19                 |
| Channel-to-Channel Crosstalk                             | –70         |                      | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 20                 |
| Total Harmonic Distortion, THD + N                       | 0.06        |                      | % typ             | $R_L = 110\ \Omega$ , $5\text{ V p-p}$ , $f = 20\text{ Hz to } 20\text{ kHz}$ ; see Figure 22 |
| –3 dB Bandwidth                                          |             |                      |                   | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 21                                      |
| ADG1408-EP                                               | 40          |                      | MHz typ           |                                                                                               |
| ADG1409-EP                                               | 80          |                      | MHz typ           |                                                                                               |
| Insertion Loss                                           | 0.5         |                      | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 21                 |
| $C_S$ (Off)                                              | 20          |                      | pF typ            | $f = 1\text{ MHz}$                                                                            |
| $C_D$ (Off)                                              |             |                      |                   |                                                                                               |
| ADG1408-EP                                               | 130         |                      | pF typ            | $f = 1\text{ MHz}$                                                                            |
| ADG1409-EP                                               | 65          |                      | pF typ            | $f = 1\text{ MHz}$                                                                            |
| $C_D$ , $C_S$ (On)                                       |             |                      |                   |                                                                                               |
| ADG1408-EP                                               | 180         |                      | pF typ            | $f = 1\text{ MHz}$                                                                            |
| ADG1409-EP                                               | 120         |                      | pF typ            | $f = 1\text{ MHz}$                                                                            |

# ADG1408-EP/ADG1409-EP

| Parameter          | +25°C | –55°C to +125°C    | Unit                                   | Test Conditions/Comments                                                                |
|--------------------|-------|--------------------|----------------------------------------|-----------------------------------------------------------------------------------------|
| POWER REQUIREMENTS |       |                    |                                        |                                                                                         |
| $I_{DD}$           | 0.001 | 1                  | $\mu\text{A typ}$<br>$\mu\text{A max}$ | $V_{DD} = +5.5\text{ V}$ , $V_{SS} = -5.5\text{ V}$<br>Digital inputs = 0 V or $V_{DD}$ |
| $I_{SS}$           | 0.001 | 1                  | $\mu\text{A typ}$<br>$\mu\text{A max}$ | Digital inputs = 0 V, 5 V or $V_{DD}$                                                   |
| $V_{DD}/V_{SS}$    |       | $\pm 4.5/\pm 16.5$ | V min/max                              |                                                                                         |

<sup>1</sup> Guaranteed by design, not subject to production test.

## CONTINUOUS CURRENT PER CHANNEL, S OR D

Table 4.

| Parameter                               | 25°C | 85°C | 125°C | Unit   | Test Conditions/Comments                              |
|-----------------------------------------|------|------|-------|--------|-------------------------------------------------------|
| CONTINUOUS CURRENT, S or D <sup>1</sup> |      |      |       |        |                                                       |
| 15 V Dual Supply                        |      |      |       |        | $V_{DD} = +13.5\text{ V}$ , $V_{SS} = -13.5\text{ V}$ |
| ADG1408-EP                              | 190  | 105  | 50    | mA max |                                                       |
| ADG1409-EP                              | 140  | 85   | 45    | mA max |                                                       |
| 12 V Single Supply                      |      |      |       |        | $V_{DD} = 10.8\text{ V}$ , $V_{SS} = 0\text{ V}$      |
| ADG1408-EP                              | 160  | 95   | 50    | mA max |                                                       |
| ADG1409-EP                              | 120  | 75   | 40    | mA max |                                                       |
| 5 V Dual Supply                         |      |      |       |        | $V_{DD} = +4.5\text{ V}$ , $V_{SS} = -4.5\text{ V}$   |
| ADG1408-EP                              | 155  | 90   | 45    | mA max |                                                       |
| ADG1409-EP                              | 115  | 70   | 40    | mA max |                                                       |

<sup>1</sup> Guaranteed by design, not subject to production test.

## ABSOLUTE MAXIMUM RATINGS

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

Table 5.

| 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 Inputs, Digital Inputs <sup>1</sup>                    | $V_{SS} - 0.3\text{ V}$ to $V_{DD} + 0.3\text{ V}$<br>or 30 mA, whichever occurs first |
| Continuous Current, S or D                                    | Table 4 data + 10%                                                                     |
| Peak Current, S or D (Pulsed at 1 ms, 10% Duty Cycle Maximum) | 350 mA                                                                                 |
| Operating Temperature Range                                   | −55°C to +125°C                                                                        |
| Storage Temperature Range                                     | −65°C to +150°C                                                                        |
| Junction Temperature                                          | 150°C                                                                                  |
| $\theta_{JA}$                                                 | 150.4°C/W                                                                              |
| $\theta_{JC}$                                                 | 50°C/W                                                                                 |
| Lead Temperature, Soldering                                   |                                                                                        |
| Vapor Phase (60 sec)                                          | 215°C                                                                                  |
| Infrared (15 sec)                                             | 220°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.

Only one absolute maximum rating can be applied at any one time.

### ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

# ADG1408-EP/ADG1409-EP

## PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

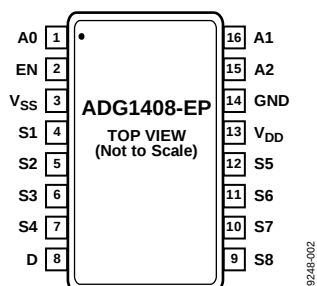


Figure 2. ADG1408-EP Pin Configuration

Table 6. ADG1408-EP Pin Function Descriptions

| Pin No. |       | Mnemonic        | Description                                                                                                                                                                                            |
|---------|-------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TSSOP   | LFCSP |                 |                                                                                                                                                                                                        |
| 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 <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.                                                                                                                                                                                   |
|         | EP    | Exposed pad     | The exposed pad is connected internally. For increased reliability of the solder joints and maximum thermal capability, it is recommended that the pad be soldered to the substrate, V <sub>SS</sub> . |

Table 7. ADG1408-EP 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         |

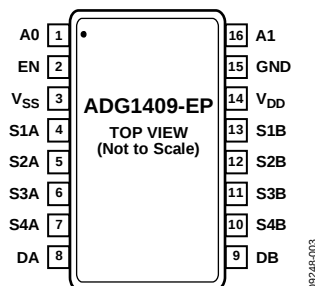


Figure 3. ADG1409-EP Pin Configuration (TSSOP)

Table 8. ADG1409-EP Pin Function Descriptions

| Pin No. |       | Mnemonic        | Description                                                                                                                                                                                            |
|---------|-------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TSSOP   | LFCSP |                 |                                                                                                                                                                                                        |
| 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 <sub>SS</sub> | 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 <sub>DD</sub> | Most Positive Power Supply Potential.                                                                                                                                                                  |
| 15      | 13    | GND             | Ground (0 V) Reference.                                                                                                                                                                                |
| 16      | 14    | A1              | Logic Control Input.                                                                                                                                                                                   |
|         | EP    | Exposed pad     | The exposed pad is connected internally. For increased reliability of the solder joints and maximum thermal capability, it is recommended that the pad be soldered to the substrate, V <sub>SS</sub> . |

Table 9. ADG1409-EP 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

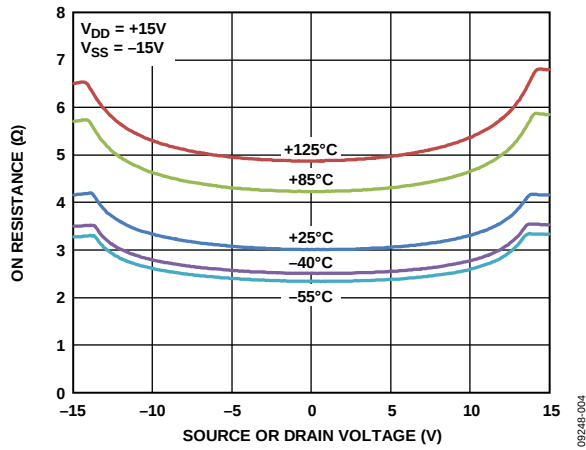


Figure 4. On Resistance vs.  $V_D$ ,  $V_S$  for Different Temperatures; 15 V Dual Supply

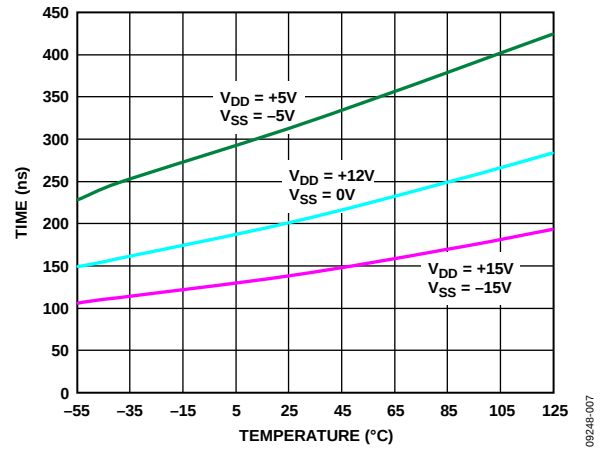


Figure 7. Transition Time vs. Temperature

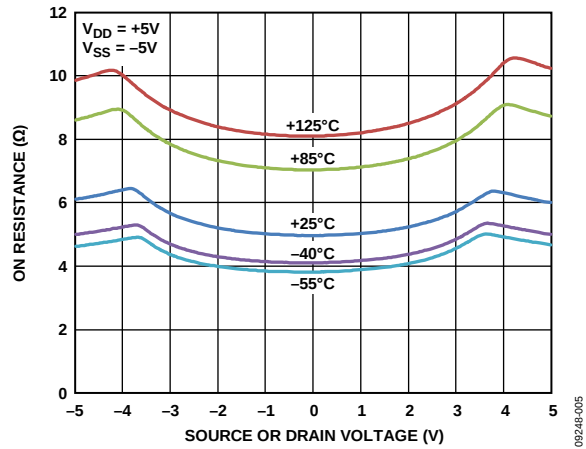


Figure 5. On Resistance vs.  $V_D$ ,  $V_S$  for Different Temperatures; 5 V Dual Supply

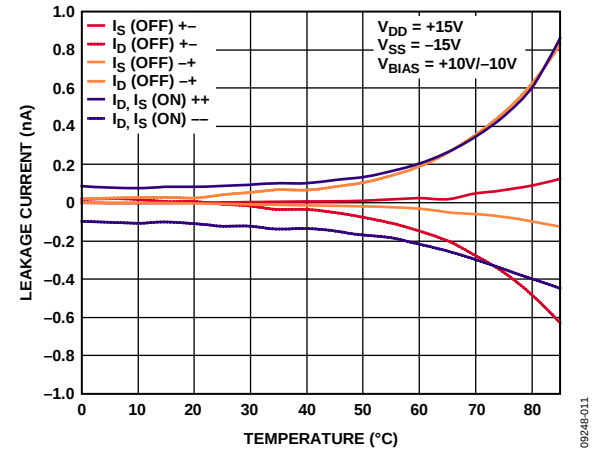


Figure 8. Leakage Current vs. Temperature; 15 V Dual Supply

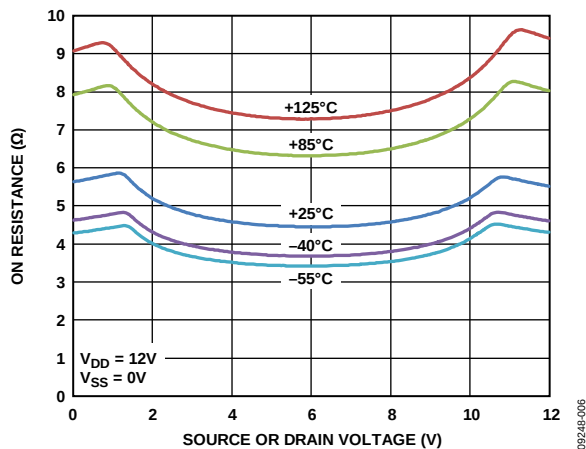


Figure 6. On Resistance vs.  $V_D$ ,  $V_S$  for Different Temperatures; 12 V Single Supply

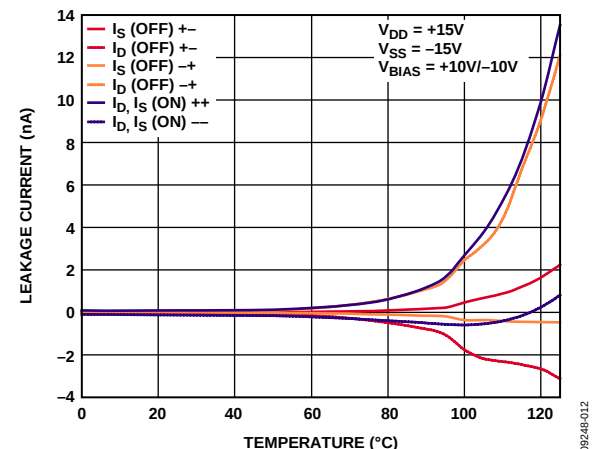


Figure 9. Leakage Current vs. Temperature; 15 V Dual Supply

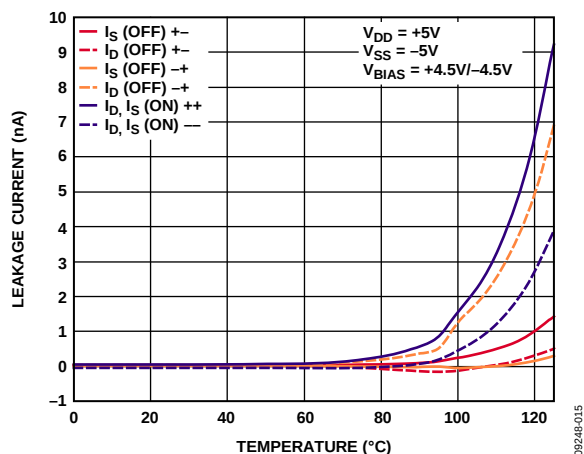


Figure 10. Leakage Current vs. Temperature;  
5 V Dual Supply

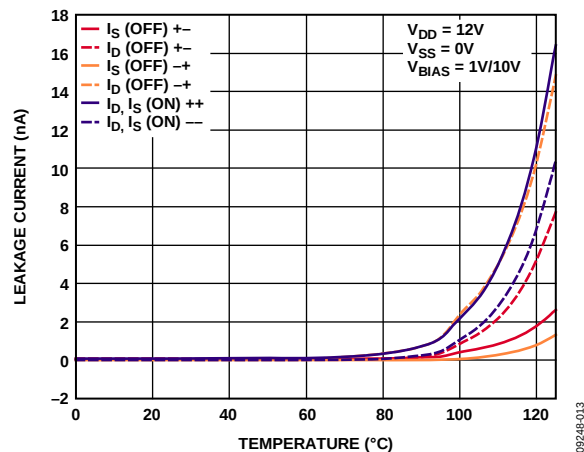


Figure 11. Leakage Current vs. Temperature;  
12 V Single Supply

# ADG1408-EP/ADG1409-EP

## TEST CIRCUITS

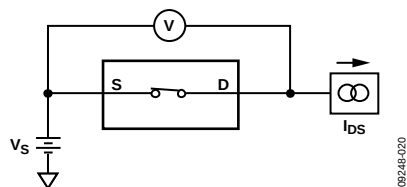


Figure 12. On Resistance

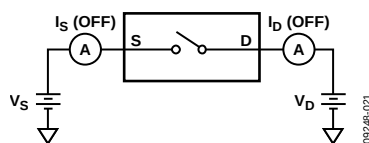


Figure 13. Off Leakage

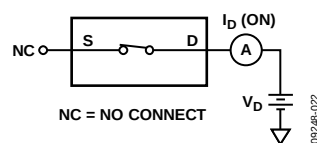


Figure 14. On Leakage

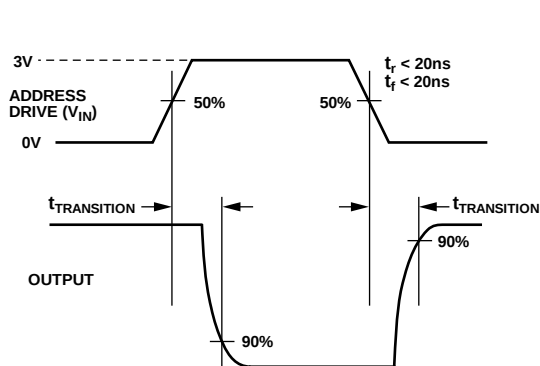
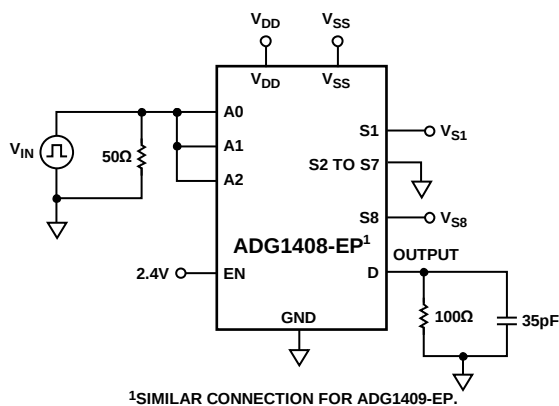


Figure 15. Address to Output Switching Times,  $t_{\text{TRANSITION}}$



<sup>1</sup>SIMILAR CONNECTION FOR ADG1409-EP.

09248-023

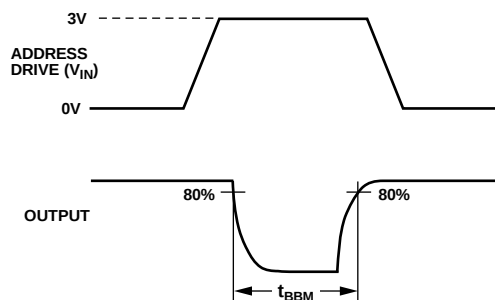
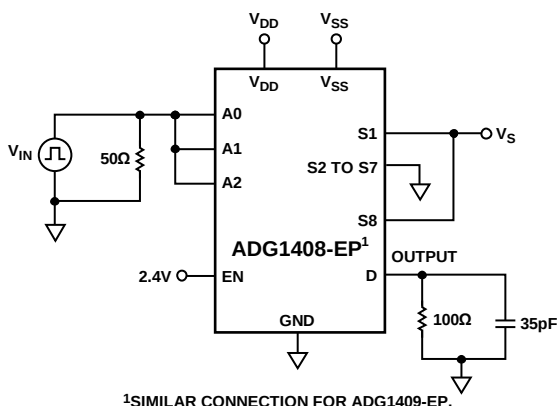


Figure 16. Break-Before-Make Delay,  $t_{\text{BBM}}$



<sup>1</sup>SIMILAR CONNECTION FOR ADG1409-EP.

09248-024

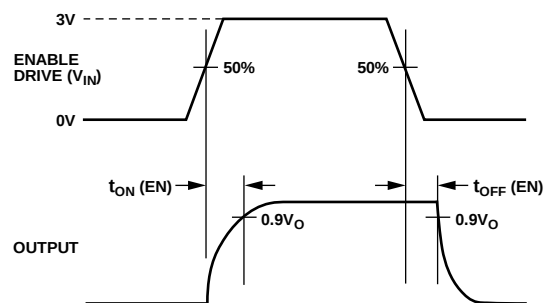
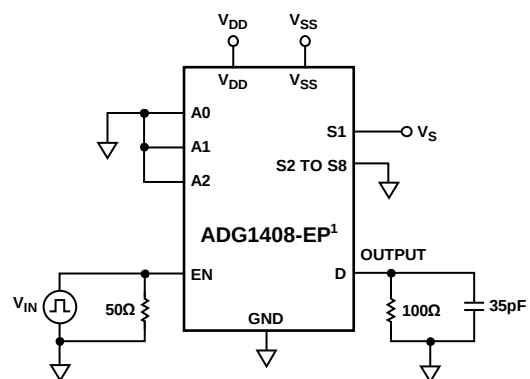


Figure 17. Enable Delay,  $t_{\text{ON}}(\text{EN})$ ,  $t_{\text{OFF}}(\text{EN})$



<sup>1</sup>SIMILAR CONNECTION FOR ADG1409-EP.

09248-025

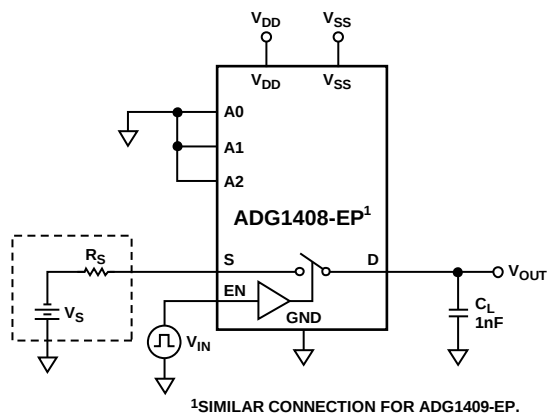
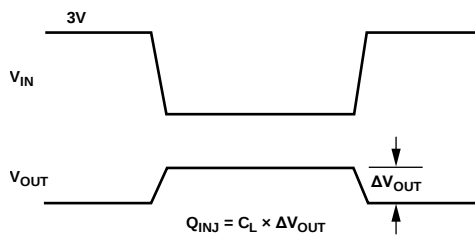


Figure 18. Charge Injection

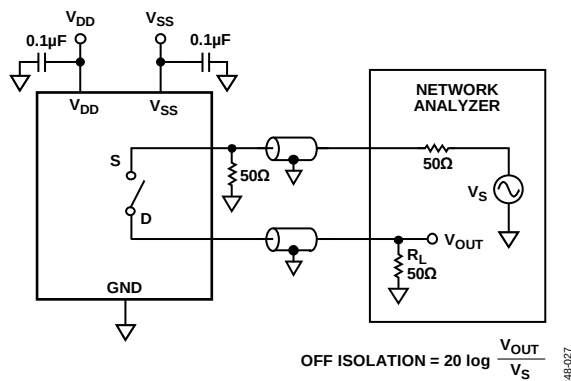


Figure 19. Off Isolation

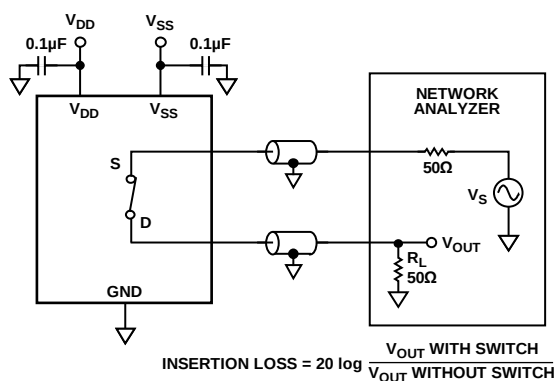


Figure 21. Insertion Loss

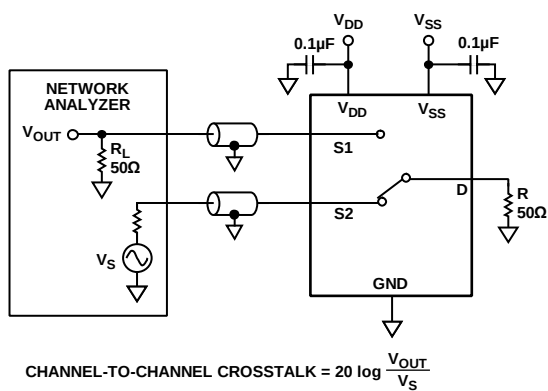


Figure 20. Channel-to-Channel Crosstalk

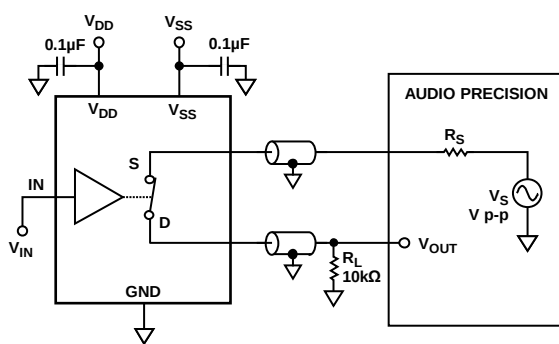
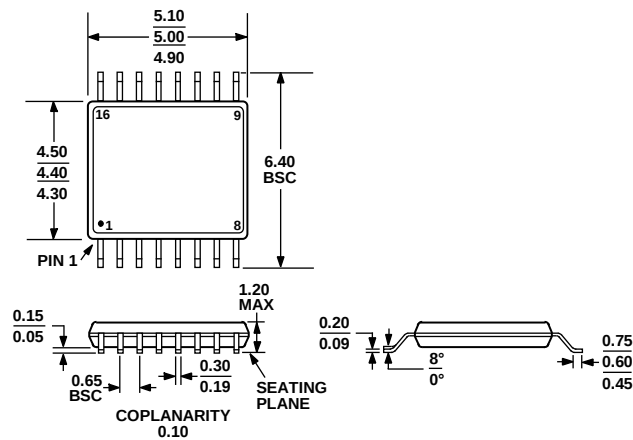


Figure 22. THD + Noise

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AB  
Figure 23. 16-Lead Thin Shrink Small Outline Package [TSSOP]  
(RU-16)  
Dimensions shown in millimeters

ORDERING GUIDE

| Model             | Temperature Range | Package Description                               | Package Option |
|-------------------|-------------------|---------------------------------------------------|----------------|
| ADG1408SRU-EP     | –55°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |
| ADG1408SRU-EP-RL7 | –55°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |
| ADG1409SRU-EP     | –55°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |
| ADG1409SRU-EP-RL7 | –55°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |