



**THE DATASHEET OF
ADG1609BRUZ**





FEATURES

- 4.5 Ω typical on resistance
- 1 Ω on-resistance flatness
- Up to 470 mA continuous current
- ±3.3 V to ±8 V dual-supply operation
- 3.3 V to 16 V single-supply operation
- No V_L supply required
- 3 V logic-compatible inputs
- Rail-to-rail operation
- 16-lead TSSOP and 16-lead, 3 mm × 3 mm LFCSP

APPLICATIONS

- Communication systems
- Medical systems
- Audio signal routing
- Video signal routing
- Automatic test equipment
- Data acquisition systems
- Battery-powered systems
- Sample-and-hold systems
- Relay replacements

GENERAL DESCRIPTION

The ADG1608/ADG1609 are monolithic CMOS analog multiplexers comprising eight single channels and four differential channels, respectively. The ADG1608 switches one of eight inputs to a common output, as determined by the 3-bit binary address lines, A0, A1, and A2. The ADG1609 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.

Each switch conducts equally well in both directions when on and has an input signal range that extends to the supplies. In the off condition, signal levels up to the supplies are blocked. All switches exhibit break-before-make switching action. Inherent in the design is low charge injection for minimum transients when switching the digital inputs.

FUNCTIONAL BLOCK DIAGRAMS

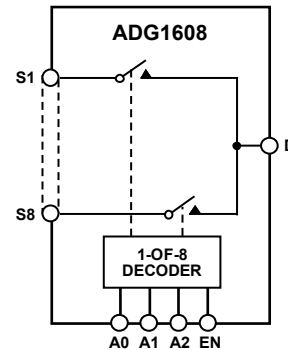


Figure 1.

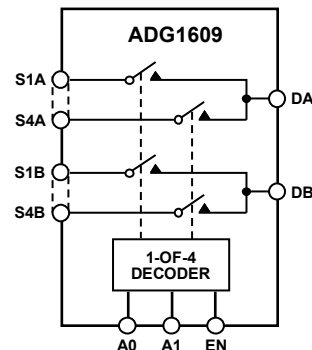


Figure 2.

The low on resistance of these switches make them ideal solutions for data acquisition and gain switching applications where low on resistance and distortion is critical. The on-resistance profile is very flat over the full analog input range, ensuring excellent linearity and low distortion when switching audio signals.

CMOS construction ensures ultralow power dissipation, making the parts ideally suited for portable and battery-powered instruments.

PRODUCT HIGHLIGHTS

- 8 Ω maximum on resistance over temperature.
- Minimum distortion: THD + N = 0.04%
- 3 V logic-compatible digital inputs: V_{INH} = 2.0 V, V_{INL} = 0.8 V.
- No V_L logic power supply required.
- Ultralow power dissipation: <8 nW.
- 16-lead TSSOP and 16-lead, 3 mm × 3 mm LFCSP.

Rev. A

[Document Feedback](#)

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

TABLE OF CONTENTS

| | | | |
|---------------------------------|---|--|----|
| Features | 1 | Continuous Current per Channel, S or D | 7 |
| Applications | 1 | Absolute Maximum Ratings | 8 |
| Functional Block Diagrams | 1 | ESD Caution | 8 |
| General Description | 1 | Pin Configurations and Function Descriptions | 9 |
| Product Highlights | 1 | Typical Performance Characteristics | 11 |
| Revision History | 2 | Test Circuits | 14 |
| Specifications | 3 | Terminology | 17 |
| ±5 V Dual Supply | 3 | Outline Dimensions | 18 |
| 12 V Single Supply | 4 | Ordering Guide | 18 |
| 5 V Single Supply | 5 | | |
| 3.3 V Single Supply | 6 | | |

REVISION HISTORY

| | |
|----------------------------------|----|
| 9/15—Rev. 0 to Rev. A | |
| Change to Table 7 | 8 |
| Updated Outline Dimensions | 18 |

7/09—Revision 0: Initial Version

SPECIFICATIONS

±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 1.

| Parameter | 25°C | -40°C to +85°C | -40°C to +125°C | Unit | Test Conditions/Comments |
|--|------------|----------------|----------------------|-------------------|---|
| ANALOG SWITCH | | | | | |
| Analog Signal Range | | | V_{DD} to V_{SS} | V | |
| On Resistance (R_{ON}) | 4.5 | | | Ω typ | $V_S = \pm 4.5\text{ V}$, $I_S = -10\text{ mA}$; see Figure 25 |
| | 5 | 7 | 8 | Ω max | $V_{DD} = \pm 4.5\text{ V}$, $V_{SS} = \pm 4.5\text{ V}$ |
| On-Resistance Match Between Channels (ΔR_{ON}) | 0.12 | | | Ω typ | $V_S = \pm 4.5\text{ V}$, $I_S = -10\text{ mA}$ |
| | 0.25 | 0.3 | 0.35 | Ω max | |
| On-Resistance Flatness ($R_{FLAT(ON)}$) | 1 | | | Ω typ | $V_S = \pm 4.5\text{ V}$, $I_S = -10\text{ mA}$ |
| | 1.3 | 1.7 | 2 | Ω max | |
| LEAKAGE CURRENTS | | | | | |
| Source Off Leakage, I_S (Off) | ± 0.02 | | | nA typ | $V_{DD} = +5.5\text{ V}$, $V_{SS} = -5.5\text{ V}$ |
| | ± 0.1 | ± 0.5 | ± 3 | nA max | $V_S = \pm 4.5\text{ V}$, $V_D = \mp 4.5\text{ V}$; see Figure 26 |
| Drain Off Leakage, I_D (Off) | ± 0.03 | | | nA typ | $V_S = \pm 4.5\text{ V}$, $V_D = \mp 4.5\text{ V}$; see Figure 26 |
| ADG1608 | ± 0.15 | ± 2 | ± 14 | nA max | |
| ADG1609 | ± 0.15 | ± 1 | ± 7 | nA max | |
| Channel On Leakage, I_D , I_S (On) | ± 0.03 | | | nA typ | $V_S = V_D = \pm 4.5\text{ V}$; see Figure 27 |
| | ± 0.15 | ± 2 | ± 14 | nA max | |
| DIGITAL INPUTS | | | | | |
| 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} | ± 1 | | | nA typ | $V_{IN} = V_{GND}$ or V_{DD} |
| | | | ± 0.1 | μA max | |
| Digital Input Capacitance, C_{IN} | 4 | | | pF typ | |
| DYNAMIC CHARACTERISTICS¹ | | | | | |
| Transition Time, $t_{TRANSITION}$ | 150 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 182 | 230 | 258 | ns max | $V_S = 2.5\text{ V}$; see Figure 28 |
| t_{ON} (EN) | 106 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 132 | 150 | 160 | ns max | $V_S = 2.5\text{ V}$; see Figure 30 |
| t_{OFF} (EN) | 113 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 144 | 178 | 202 | ns max | $V_S = 2.5\text{ V}$; see Figure 30 |
| Break-Before-Make Time Delay, t_D | 47 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | | | 30 | ns min | $V_{S1} = V_{S2} = 2.5\text{ V}$; see Figure 29 |
| Charge Injection | 24 | | | pC typ | $V_S = 0\text{ V}$, $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$; see Figure 31 |
| Off Isolation | -64 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 32 |
| Channel-to-Channel Crosstalk | -64 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 34 |
| Total Harmonic Distortion + Noise (THD + N) | 0.04 | | | % typ | $R_L = 110\ \Omega$, $V_S = 5\text{ V}$ p-p, $f = 20\text{ Hz}$ to 20 kHz ; see Figure 35 |
| -3 dB Bandwidth | | | | | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$; see Figure 33 |
| ADG1608 | 40 | | | MHz typ | |
| ADG1609 | 71 | | | MHz typ | |
| C_S (Off) | 20 | | | pF typ | $V_S = 0\text{ V}$, $f = 1\text{ MHz}$ |
| C_D (Off) | | | | | |
| ADG1608 | 120 | | | pF typ | $V_S = 0\text{ V}$, $f = 1\text{ MHz}$ |
| ADG1609 | 61 | | | pF typ | $V_S = 0\text{ V}$, $f = 1\text{ MHz}$ |
| C_D , C_S (On) | | | | | |
| ADG1608 | 153 | | | pF typ | $V_S = 0\text{ V}$, $f = 1\text{ MHz}$ |
| ADG1609 | 85 | | | pF typ | $V_S = 0\text{ V}$, $f = 1\text{ MHz}$ |
| POWER REQUIREMENTS | | | | | |
| I_{DD} | 0.001 | | | μA typ | $V_{DD} = +5.5\text{ V}$, $V_{SS} = -5.5\text{ V}$ |
| | | | 1.0 | μA max | Digital inputs = 0 V or V_{DD} |
| V_{DD}/V_{SS} | | | $\pm 3.3/\pm 8$ | V min/max | |

¹ Guaranteed by design, but 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 | -40°C to +85°C | -40°C to +125°C | Unit | Test Conditions/Comments |
|--|------------|----------------|-----------------|-------------------|---|
| ANALOG SWITCH | | | | | |
| Analog Signal Range | | | 0 V to V_{DD} | V | |
| On Resistance (R_{ON}) | 4 | | | Ω typ | $V_S = 0\text{ V}$ to 10 V, $I_S = -10\text{ mA}$; see Figure 25 |
| | 4.5 | 6.5 | 7.5 | Ω max | $V_{DD} = 10.8\text{ V}$, $V_{SS} = 0\text{ V}$ |
| On-Resistance Match Between Channels (ΔR_{ON}) | 0.12 | | | Ω typ | $V_S = 10\text{ V}$, $I_S = -10\text{ mA}$ |
| | 0.25 | 0.3 | 0.35 | Ω max | |
| On-Resistance Flatness ($R_{FLAT(ON)}$) | 0.9 | | | Ω typ | $V_S = 0\text{ V}$ to 10 V, $I_S = -10\text{ mA}$ |
| | 1.2 | 1.6 | 1.9 | Ω max | |
| LEAKAGE CURRENTS | | | | | |
| Source Off Leakage, I_S (Off) | ± 0.02 | | | nA typ | $V_{DD} = 13.2\text{ V}$, $V_{SS} = 0\text{ V}$ |
| | ± 0.1 | ± 0.5 | ± 3 | nA max | $V_S = 1\text{ V}/10\text{ V}$, $V_D = 10\text{ V}/1\text{ V}$; see Figure 26 |
| Drain Off Leakage, I_D (Off) | ± 0.03 | | | nA typ | $V_S = 1\text{ V}/10\text{ V}$, $V_D = 10\text{ V}/1\text{ V}$; see Figure 26 |
| ADG1608 | ± 0.15 | ± 2 | ± 14 | nA max | |
| ADG1609 | ± 0.15 | ± 1 | ± 7 | nA max | |
| Channel On Leakage, I_D , I_S (On) | ± 0.03 | | | nA typ | $V_S = V_D = 1\text{ V}$ or 10 V; see Figure 27 |
| | ± 0.15 | ± 2 | ± 14 | nA max | |
| DIGITAL INPUTS | | | | | |
| 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} | ± 1 | | | nA typ | $V_{IN} = V_{GND}$ or V_{DD} |
| | | | ± 0.1 | μA max | |
| Digital Input Capacitance, C_{IN} | 4 | | | pF typ | |
| DYNAMIC CHARACTERISTICS¹ | | | | | |
| Transition Time, $t_{TRANSITION}$ | 113 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 141 | 172 | 196 | ns max | $V_S = 8\text{ V}$; see Figure 28 |
| t_{ON} (EN) | 80 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 94 | 101 | 110 | ns max | $V_S = 8\text{ V}$; see Figure 30 |
| t_{OFF} (EN) | 77 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 93 | 117 | 140 | ns max | $V_S = 8\text{ V}$; see Figure 30 |
| Break-Before-Make Time Delay, t_D | 47 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | | | 30 | ns min | $V_{S1} = V_{S2} = 8\text{ V}$; see Figure 29 |
| Charge Injection | 29 | | | pC typ | $V_S = 6\text{ V}$, $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$; see Figure 31 |
| Off Isolation | -64 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 32 |
| Channel-to-Channel Crosstalk | -64 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; see Figure 34 |
| Total Harmonic Distortion + Noise (THD + N) | 0.04 | | | % typ | $R_L = 110\ \Omega$, $V_S = 5\text{ V}$ p-p, $f = 20\text{ Hz}$ to 20 kHz; see Figure 35 |
| -3 dB Bandwidth | | | | | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$; see Figure 33 |
| ADG1608 | 40 | | | MHz typ | |
| ADG1609 | 78 | | | MHz typ | |
| C_S (Off) | 19 | | | pF typ | $V_S = 6\text{ V}$, $f = 1\text{ MHz}$ |
| C_D (Off) | | | | | |
| ADG1608 | 117 | | | pF typ | $V_S = 6\text{ V}$, $f = 1\text{ MHz}$ |
| ADG1609 | 59 | | | pF typ | $V_S = 6\text{ V}$, $f = 1\text{ MHz}$ |
| C_D , C_S (On) | | | | | |
| ADG1608 | 149 | | | pF typ | $V_S = 6\text{ V}$, $f = 1\text{ MHz}$ |
| ADG1609 | 84 | | | pF typ | $V_S = 6\text{ V}$, $f = 1\text{ MHz}$ |
| POWER REQUIREMENTS | | | | | |
| I_{DD} | 0.001 | | | μA typ | $V_{DD} = 12\text{ V}$ |
| | | | 1.0 | μA max | Digital inputs = 0 V or V_{DD} |
| ADG1608 | 300 | | | μA typ | Digital inputs = 5 V |
| | | | 480 | μA max | |
| ADG1609 | 225 | | | μA typ | Digital inputs = 5 V |
| | | | 360 | μA max | |
| V_{DD} | | | 3.3/16 | V min/max | |

¹ Guaranteed by design, but not subject to production test.

5 V SINGLE SUPPLY

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

Table 3.

| Parameter | 25°C | -40°C to +85°C | -40°C to +125°C | Unit | Test Conditions/Comments |
|--|------------|-------------------|--------------------|-------------------|---|
| ANALOG SWITCH | | | | | |
| Analog Signal Range | | | 0 V to V_{DD} | V | |
| On Resistance (R_{ON}) | 8.5 | | | Ω typ | $V_S = 0\text{ V}$ to 4.5 V, $I_S = -10\text{ mA}$; see Figure 25 |
| | 10 | 12.5 | 14 | Ω max | $V_{DD} = 4.5\text{ V}$, $V_{SS} = 0\text{ V}$ |
| On-Resistance Match Between Channels (ΔR_{ON}) | 0.15 | | | Ω typ | $V_S = 0\text{ V}$ to 4.5 V, $I_S = -10\text{ mA}$ |
| | 0.3 | 0.35 | 0.4 | Ω max | |
| On-Resistance Flatness ($R_{FLAT(ON)}$) | 1.7 | | | Ω typ | $V_S = 0\text{ V}$ to 4.5 V, $I_S = -10\text{ mA}$ |
| | 2.3 | 2.7 | 3 | Ω max | |
| LEAKAGE CURRENTS | | | | | |
| Source Off Leakage, I_S (Off) | ± 0.01 | | | nA typ | $V_{DD} = 5.5\text{ V}$, $V_{SS} = 0\text{ V}$ |
| | ± 0.1 | ± 0.5 | ± 3 | nA max | $V_S = 1\text{ V}/4.5\text{ V}$, $V_D = 4.5\text{ V}/1\text{ V}$; see Figure 26 |
| Drain Off Leakage, I_D (Off) | ± 0.01 | | | nA typ | |
| ADG1608 | ± 0.15 | ± 2 | ± 14 | nA max | $V_S = 1\text{ V}/4.5\text{ V}$, $V_D = 4.5\text{ V}/1\text{ V}$; see Figure 26 |
| ADG1609 | ± 0.15 | ± 1 | ± 7 | nA max | |
| Channel On Leakage, I_D , I_S (On) | ± 0.01 | | | nA typ | $V_S = V_D = 1\text{ V}$ or 4.5 V; see Figure 27 |
| | ± 0.15 | ± 2 | ± 14 | nA max | |
| DIGITAL INPUTS | | | | | |
| 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} | ± 1 | | | nA typ | $V_{IN} = V_{GND}$ or V_{DD} |
| | | | ± 0.1 | μA max | |
| Digital Input Capacitance, C_{IN} | 4 | | | pF typ | |
| DYNAMIC CHARACTERISTICS¹ | | | | | |
| Transition Time, $t_{TRANSITION}$ | 193 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 251 | 301 | 339 | ns max | $V_S = 2.5\text{ V}$; see Figure 28 |
| t_{ON} (EN) | 115 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 152 | 171 | 184 | ns max | $V_S = 2.5\text{ V}$; see Figure 30 |
| t_{OFF} (EN) | 140 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 184 | 225 | 259 | ns max | $V_S = 2.5\text{ V}$; see Figure 30 |
| Break-Before-Make Time Delay, t_D | 66 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | | | 37 | ns min | $V_{S1} = V_{S2} = 2.5\text{ V}$; see Figure 29 |
| Charge Injection | 11 | | | pC typ | $V_S = 2.5\text{ V}$, $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$; see Figure 31 |
| Off Isolation | -64 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 100\text{ kHz}$; see Figure 32 |
| Channel-to-Channel Crosstalk | -64 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 100\text{ kHz}$; see Figure 34 |
| Total Harmonic Distortion + Noise (THD + N) | 0.3 | | | % typ | $R_L = 110\ \Omega$, $f = 20\text{ Hz}$ to 20 kHz, $V_S = 3.5\text{ V}$ p-p; see Figure 35 |
| -3 dB Bandwidth | | | | | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$; see Figure 33 |
| ADG1608 | 37 | | | MHz typ | |
| ADG1609 | 72 | | | MHz typ | |
| C_S (Off) | 22 | | | pF typ | $V_S = 2.5\text{ V}$, $f = 1\text{ MHz}$ |
| C_D (Off) | | | | | $V_S = 2.5\text{ V}$, $f = 1\text{ MHz}$ |
| ADG1608 | 136 | | | pF typ | |
| ADG1609 | 68 | | | pF typ | |
| C_D , C_S (On) | | | | | $V_S = 2.5\text{ V}$, $f = 1\text{ MHz}$ |
| ADG1608 | 168 | | | pF typ | |
| ADG1609 | 94 | | | pF typ | |
| POWER REQUIREMENTS | | | | | |
| I_{DD} | 0.001 | | | μA typ | $V_{DD} = 5.5\text{ V}$ |
| | | | 1.0 | μA max | Digital inputs = 0 V or V_{DD} |
| V_{DD} | | | 3.3/16 | V min/max | |

¹ Guaranteed by design, but not subject to production test.

3.3 V SINGLE SUPPLY

$V_{DD} = 3.3\text{ V}$, $V_{SS} = 0\text{ V}$, $GND = 0\text{ V}$, unless otherwise noted.

Table 4.

| Parameter | 25°C | -40°C to +85°C | -40°C to +125°C | Unit | Test Conditions/Comments |
|--|------------|----------------|-----------------|-------------------|--|
| ANALOG SWITCH | | | | | |
| Analog Signal Range | | | 0 V to V_{DD} | V | |
| On Resistance (R_{ON}) | 13.5 | 15 | 16.5 | Ω typ | $V_S = 0\text{ V}$ to V_{DD} , $I_S = -10\text{ mA}$; see Figure 25, $V_{DD} = 3.3\text{ V}$, $V_{SS} = 0\text{ V}$ |
| On-Resistance Match Between Channels (ΔR_{ON}) | 0.25 | 0.28 | 0.3 | Ω typ | $V_S = 0\text{ V}$ to V_{DD} , $I_S = -10\text{ mA}$ |
| On-Resistance Flatness ($R_{FLAT(ON)}$) | 5 | 5.5 | 6.5 | Ω typ | $V_S = 0\text{ V}$ to V_{DD} , $I_S = -10\text{ mA}$ |
| LEAKAGE CURRENTS | | | | | |
| Source Off Leakage, I_S (Off) | ± 0.01 | | | nA typ | $V_{DD} = 3.6\text{ V}$, $V_{SS} = 0\text{ V}$ $V_S = 0.6\text{ V}/3\text{ V}$, $V_D = 3\text{ V}/0.6\text{ V}$; see Figure 26 |
| Drain Off Leakage, I_D (Off) | ± 0.01 | ± 0.5 | ± 3 | nA max | |
| | ± 0.15 | ± 2 | ± 14 | nA max | $V_S = 0.6\text{ V}/3\text{ V}$, $V_D = 3\text{ V}/0.6\text{ V}$; see Figure 26 |
| ADG1608 | | | | nA max | |
| ADG1609 | | ± 1 | ± 7 | nA max | |
| Channel On Leakage, I_D , I_S (On) | ± 0.01 | | | nA typ | $V_S = V_D = 0.6\text{ V}$ or 3 V ; see Figure 27 |
| | ± 0.15 | ± 2 | ± 14 | nA max | |
| DIGITAL INPUTS | | | | | |
| 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} | ± 1 | | | nA typ | $V_{IN} = V_{GND}$ or V_{DD} |
| | | | ± 0.1 | μA max | |
| Digital Input Capacitance, C_{IN} | 4 | | | pF typ | |
| DYNAMIC CHARACTERISTICS¹ | | | | | |
| Transition Time, $t_{TRANSITION}$ | 312 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 437 | 498 | 542 | ns max | $V_S = 1.5\text{ V}$; see Figure 28 |
| t_{ON} (EN) | 216 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 309 | 331 | 344 | ns max | $V_S = 1.5\text{ V}$; see Figure 30 |
| t_{OFF} (EN) | 236 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | 316 | 367 | 411 | ns max | $V_S = 1.5\text{ V}$; see Figure 30 |
| Break-Before-Make Time Delay, t_D | 104 | | | ns typ | $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$ |
| | | | 48 | ns min | $V_{S1} = V_{S2} = 1.5\text{ V}$; see Figure 29 |
| Charge Injection | 6 | | | pC typ | $V_S = 1.5\text{ V}$, $R_S = 0\ \Omega$, $C_L = 1\text{ nF}$; see Figure 31 |
| Off Isolation | -64 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 100\text{ kHz}$; see Figure 32 |
| Channel-to-Channel Crosstalk | -64 | | | dB typ | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$, $f = 100\text{ kHz}$; see Figure 34 |
| Total Harmonic Distortion + Noise (THD + N) | 0.5 | | | % typ | $R_L = 110\ \Omega$, $f = 20\text{ Hz}$ to 20 kHz , $V_S = 2\text{ V p-p}$; see Figure 35 |
| -3 dB Bandwidth | | | | | $R_L = 50\ \Omega$, $C_L = 5\text{ pF}$; see Figure 33 |
| ADG1608 | 34 | | | MHz typ | |
| ADG1609 | 72 | | | MHz typ | |
| C_S (Off) | 23 | | | pF typ | $V_S = 1.5\text{ V}$, $f = 1\text{ MHz}$ |
| C_D (Off) | | | | | $V_S = 1.5\text{ V}$, $f = 1\text{ MHz}$ |
| ADG1608 | 145 | | | pF typ | |
| ADG1609 | 72 | | | pF typ | |
| C_D , C_S (On) | | | | | $V_S = 1.5\text{ V}$, $f = 1\text{ MHz}$ |
| ADG1608 | 173 | | | pF typ | |
| ADG1609 | 95 | | | pF typ | |
| POWER REQUIREMENTS | | | | | |
| I_{DD} | 0.001 | | | μA typ | $V_{DD} = 3.6\text{ V}$ Digital inputs = 0 V or V_{DD} |
| | | | 1.0 | μA max | |
| V_{DD} | | | 3.3/16 | V min/max | |

¹ Guaranteed by design, but not subject to production test.

CONTINUOUS CURRENT PER CHANNEL, S OR D**Table 5. ADG1608**

| Parameter | 25°C | 85°C | 125°C | Unit |
|---|------|------|-------|--------|
| CONTINUOUS CURRENT, S OR D | | | | |
| $V_{DD} = +5\text{ V}, V_{SS} = -5\text{ V}$ | | | | |
| TSSOP ($\theta_{JA} = 112.6^\circ\text{C/W}$) | 290 | 180 | 100 | mA max |
| LFCSP ($\theta_{JA} = 48.7^\circ\text{C/W}$) | 470 | 255 | 120 | mA max |
| $V_{DD} = 12\text{ V}, V_{SS} = 0\text{ V}$ | | | | |
| TSSOP ($\theta_{JA} = 112.6^\circ\text{C/W}$) | 213 | 129 | 73 | mA max |
| LFCSP ($\theta_{JA} = 48.7^\circ\text{C/W}$) | 346 | 185 | 84 | mA max |
| $V_{DD} = 5\text{ V}, V_{SS} = 0\text{ V}$ | | | | |
| TSSOP ($\theta_{JA} = 112.6^\circ\text{C/W}$) | 157 | 101 | 63 | mA max |
| LFCSP ($\theta_{JA} = 48.7^\circ\text{C/W}$) | 252 | 150 | 77 | mA max |
| $V_{DD} = 3.3\text{ V}, V_{SS} = 0\text{ V}$ | | | | |
| TSSOP ($\theta_{JA} = 112.6^\circ\text{C/W}$) | 126 | 87 | 56 | mA max |
| LFCSP ($\theta_{JA} = 48.7^\circ\text{C/W}$) | 206 | 129 | 73.5 | mA max |

Table 6. ADG1609

| Parameter | 25°C | 85°C | 125°C | Unit |
|---|------|------|-------|--------|
| CONTINUOUS CURRENT, S OR D | | | | |
| $V_{DD} = +5\text{ V}, V_{SS} = -5\text{ V}$ | | | | |
| TSSOP ($\theta_{JA} = 112.6^\circ\text{C/W}$) | 147 | 98 | 63 | mA max |
| LFCSP ($\theta_{JA} = 48.7^\circ\text{C/W}$) | 245 | 147 | 77 | mA max |
| $V_{DD} = 12\text{ V}, V_{SS} = 0\text{ V}$ | | | | |
| TSSOP ($\theta_{JA} = 112.6^\circ\text{C/W}$) | 157 | 101 | 63 | mA max |
| LFCSP ($\theta_{JA} = 48.7^\circ\text{C/W}$) | 255 | 150 | 77 | mA max |
| $V_{DD} = 5\text{ V}, V_{SS} = 0\text{ V}$ | | | | |
| TSSOP ($\theta_{JA} = 112.6^\circ\text{C/W}$) | 115 | 80 | 52 | mA max |
| LFCSP ($\theta_{JA} = 48.7^\circ\text{C/W}$) | 189 | 119 | 70 | mA max |
| $V_{DD} = 3.3\text{ V}, V_{SS} = 0\text{ V}$ | | | | |
| TSSOP ($\theta_{JA} = 112.6^\circ\text{C/W}$) | 94 | 66 | 45 | mA max |
| LFCSP ($\theta_{JA} = 48.7^\circ\text{C/W}$) | 154 | 101 | 63 | mA max |

ABSOLUTE MAXIMUM RATINGS

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

Table 7.

| Parameter | Rating |
|---|--|
| V_{DD} to V_{SS} | 18 V |
| V_{DD} to GND | -0.3 V to +18 V |
| V_{SS} to GND | +0.3 V to -18 V |
| Analog Inputs ¹ | $V_{SS} - 0.3\text{ V}$ to $V_{DD} + 0.3\text{ V}$ or 30 mA, whichever occurs first |
| Digital Inputs ¹ | GND - 0.3 V to $V_{DD} + 0.3\text{ V}$ or 30 mA, whichever occurs first |
| Peak Current, S or D | 710 mA (pulsed at 1 ms, 10% duty cycle maximum) |
| Continuous Current, S or D ² | Data + 15% |
| Operating Temperature Range | |
| Industrial | -40°C to +125°C |
| Storage Temperature Range | -65°C to +150°C |
| Junction Temperature | 150°C |
| 16-Lead TSSOP, θ_{JA} Thermal Impedance, 0 Airflow (4-Layer Board) | 112.6°C/W |
| 16-Lead LFCSP, θ_{JA} Thermal Impedance, 0 Airflow (4-Layer Board) | 48.7°C/W |
| Reflow Soldering Peak Temperature, Pb-free | 260°C |

¹ Overvoltages at IN, S, or D are clamped by internal diodes. Current should be limited to the maximum ratings given.

² See Table 5 and Table 6.

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

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.

PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

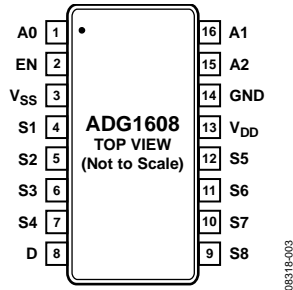
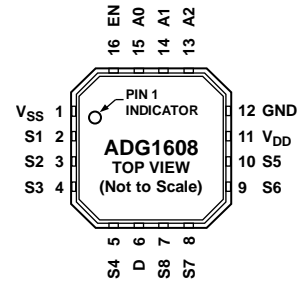


Figure 3. ADG1608 Pin Configuration (TSSOP)



NOTES
 1. 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_{SS}.

Figure 4. ADG1608 Pin Configuration (LFCSP)

Table 8. ADG1608 Pin Function Descriptions

| Pin No. | | Mnemonic | Description |
|---------|-------|-----------------|---|
| TSSOP | LFCSP | | |
| 1 | 15 | A0 | Logic Control Input. |
| 2 | 16 | EN | Active High Digital Input. When this pin is low, the device is disabled and all switches are off. When this pin is high, Ax logic inputs determine on switches. |
| 3 | 1 | V _{SS} | Most Negative Power Supply Potential. In single-supply applications, this pin 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 _{DD} | Most Positive Power Supply Potential. |
| 14 | 12 | GND | Ground (0 V) Reference. |
| 15 | 13 | A2 | Logic Control Input. |
| 16 | 14 | A1 | Logic Control Input. |
| N/A | EP | 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 _{SS} . |

Table 9. ADG1608 Truth Table

| A2 | A1 | A0 | EN | On Switch |
|----------------|----------------|----------------|----|-----------|
| X ¹ | X ¹ | X ¹ | 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 |

¹ X = don't care.

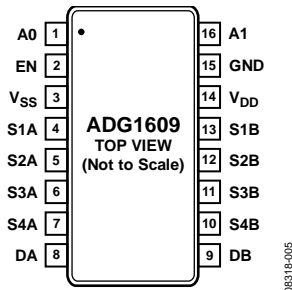
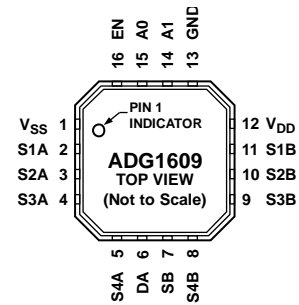


Figure 5. ADG1609 Pin Configuration (TSSOP)



NOTES
 1. 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_{SS} .

Figure 6. ADG1609 Pin Configuration (LFCSP)

Table 10. ADG1609 Pin Function Descriptions

| Pin No. | | Mnemonic | Description |
|---------|-------|----------|--|
| TSSOP | LFCSP | | |
| 1 | 15 | A0 | Logic Control Input. |
| 2 | 16 | EN | Active High Digital Input. When this pin is low, the device is disabled and all switches are off. When this pin is high, Ax logic inputs determine on switches. |
| 3 | 1 | V_{SS} | Most Negative Power Supply Potential. In single-supply applications, this pin 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. |
| N/A | EP | 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_{SS} . |

Table 11. ADG1609 Truth Table

| A1 | A0 | EN | On Switch Pair |
|----------------|----------------|----|----------------|
| X ¹ | X ¹ | 0 | None |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 2 |
| 1 | 0 | 1 | 3 |
| 1 | 1 | 1 | 4 |

¹ X = don't care.

TYPICAL PERFORMANCE CHARACTERISTICS

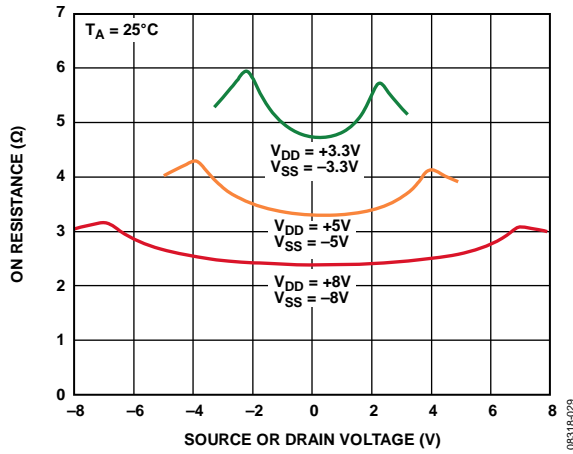


Figure 7. On Resistance vs. V_D (V_S) for Dual Supply

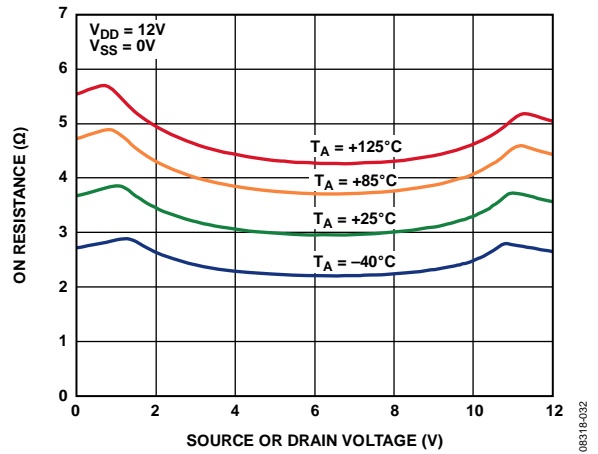


Figure 10. On Resistance vs. V_D (V_S) for Different Temperatures, 12 V Single Supply

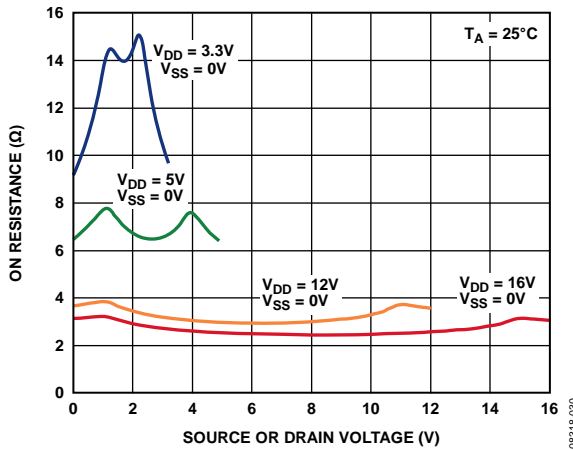


Figure 8. On Resistance vs. V_D (V_S) for Single Supply

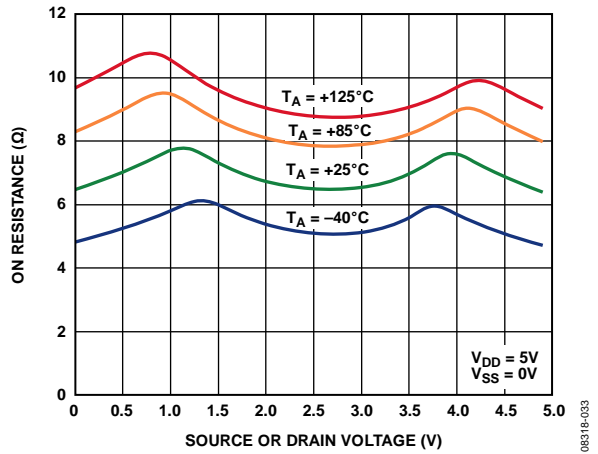


Figure 11. On Resistance vs. V_D (V_S) for Different Temperatures, 5 V Single Supply

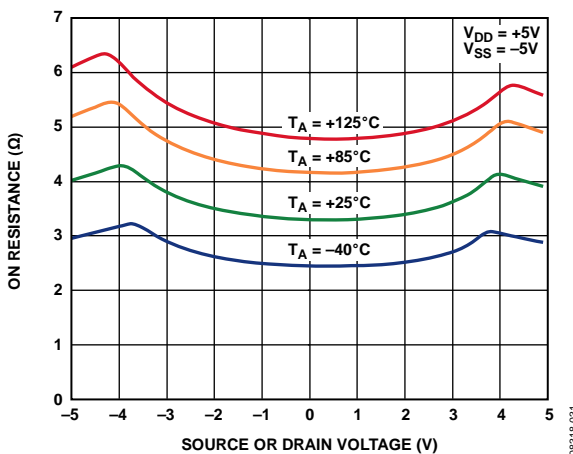


Figure 9. On Resistance vs. V_D (V_S) for Different Temperatures, ± 5 V Dual Supply

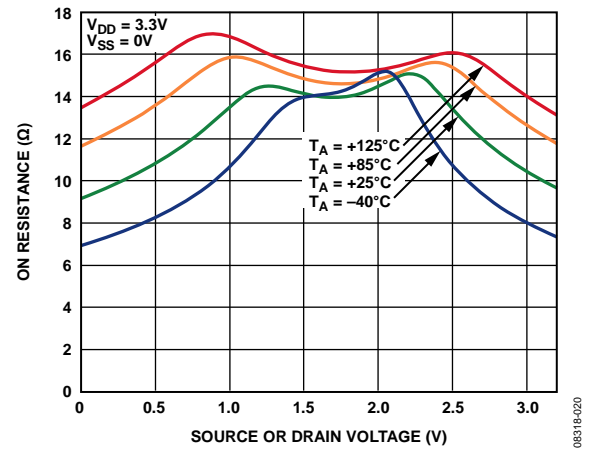


Figure 12. On Resistance vs. V_D (V_S) for Different Temperatures, 3.3 V Single Supply

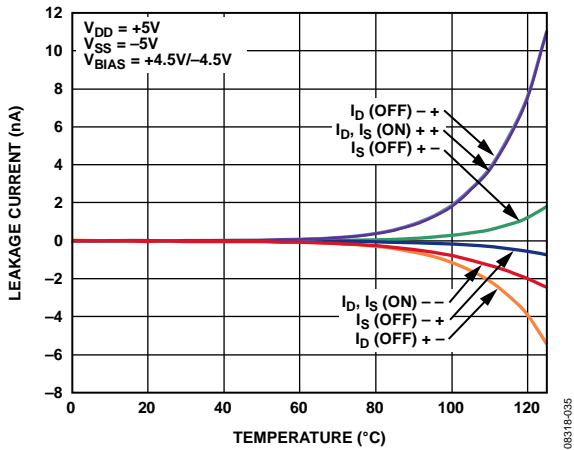


Figure 13. ADG1608 Leakage Currents vs. Temperature, ±5 V Dual Supply

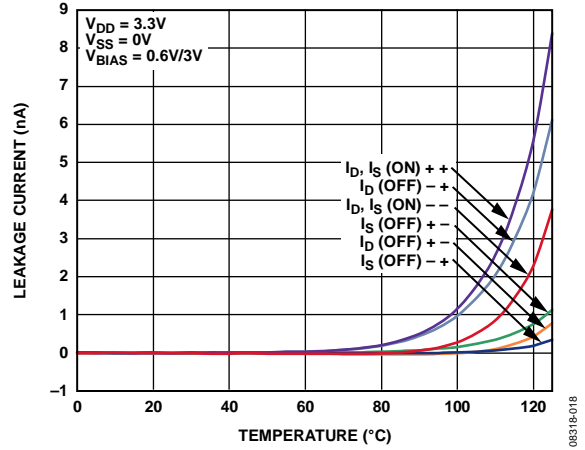


Figure 16. ADG1608 Leakage Currents vs. Temperature, 3.3 V Single Supply

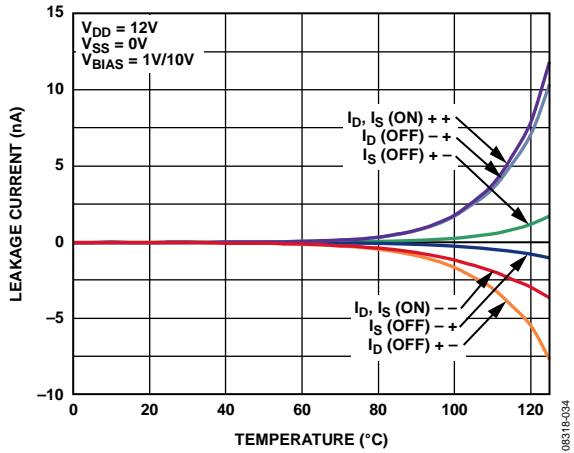


Figure 14. ADG1608 Leakage Currents vs. Temperature, 12 V Single Supply

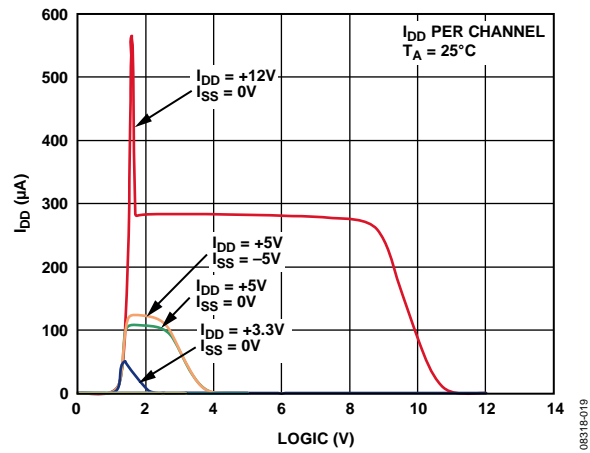


Figure 17. I_{DD} vs. Logic Level

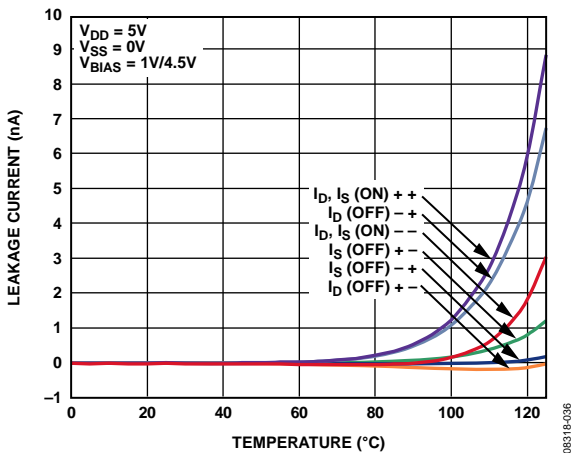


Figure 15. ADG1608 Leakage Currents vs. Temperature, 5 V Single Supply

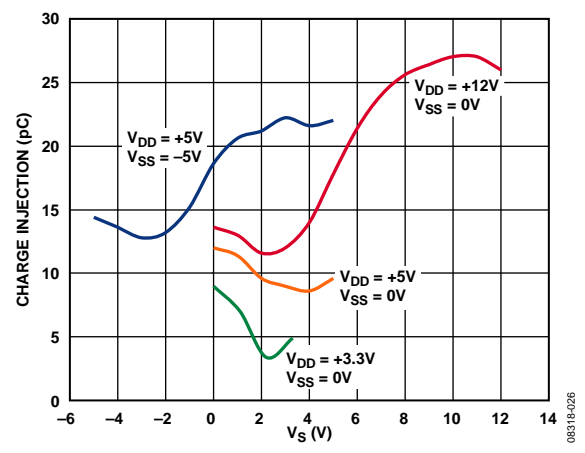


Figure 18. Charge Injection vs. Source Voltage

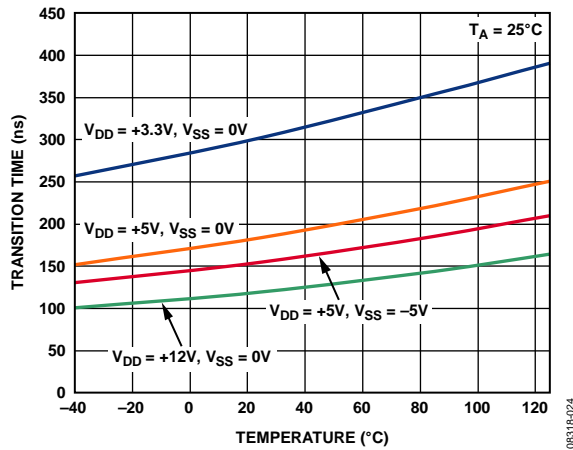


Figure 19. Transition Time vs. Temperature

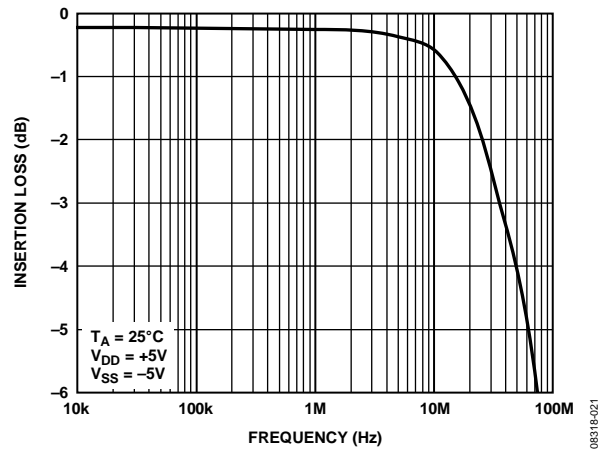


Figure 22. On Response vs. Frequency

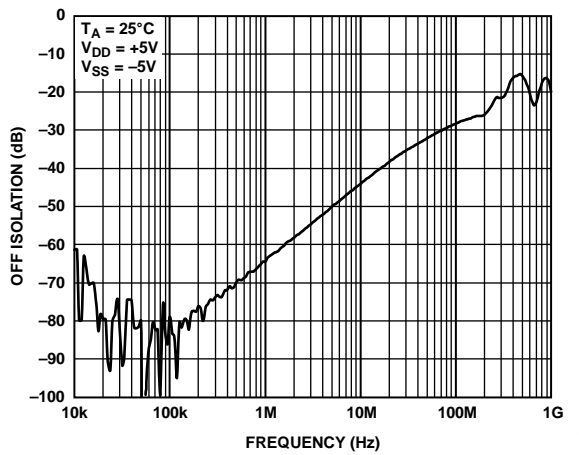


Figure 20. Off Isolation vs. Frequency

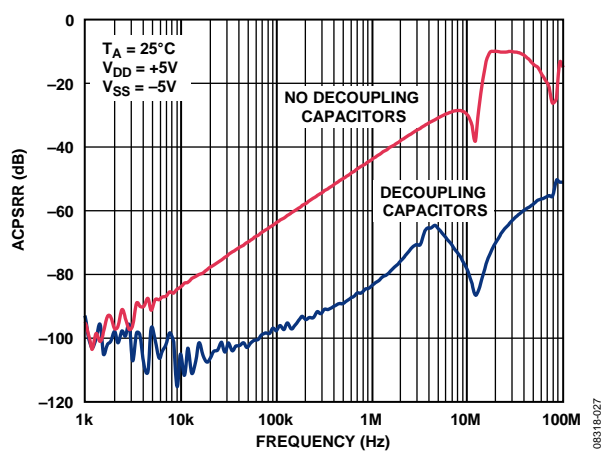


Figure 23. ACPSRR vs. Frequency

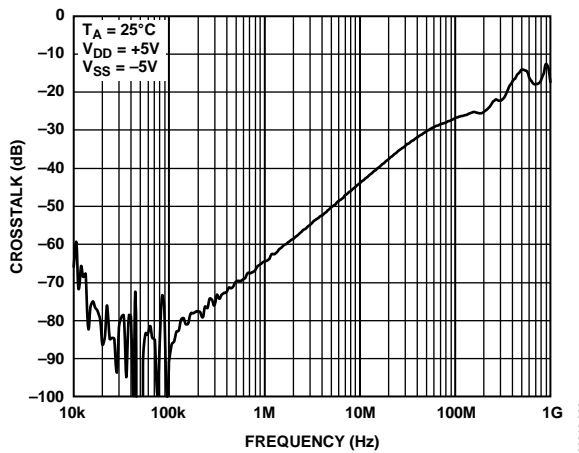


Figure 21. Crosstalk vs. Frequency

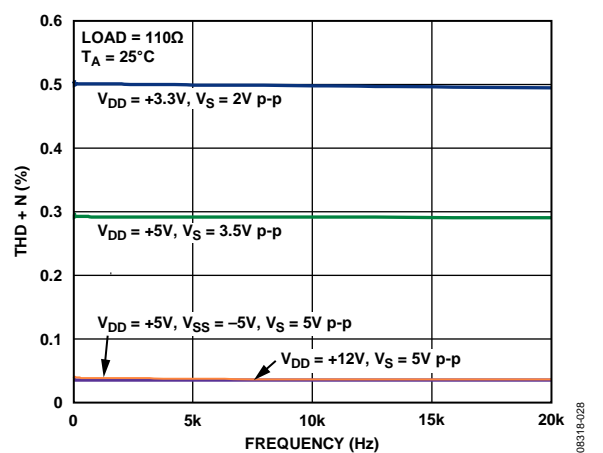


Figure 24. THD + N vs. Frequency

TEST CIRCUITS

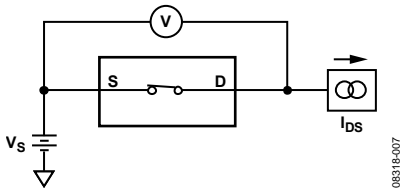


Figure 25. On Resistance

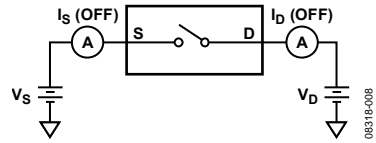


Figure 26. Off Leakage

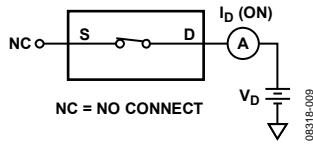


Figure 27. On Leakage

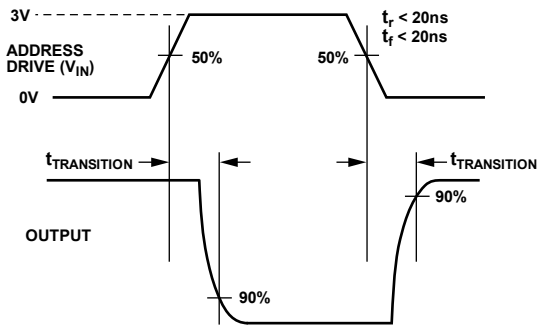
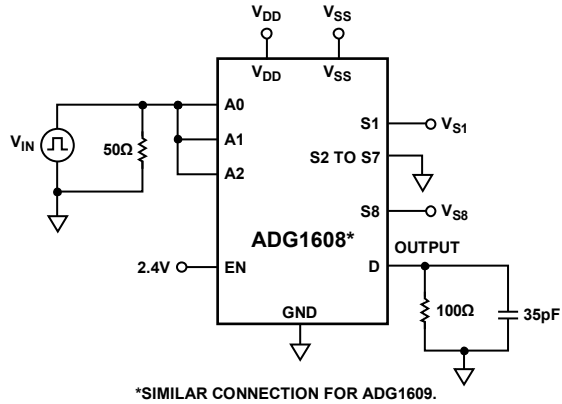


Figure 28. Address to Output Switching Times, $t_{TRANSITION}$



*SIMILAR CONNECTION FOR ADG1609.

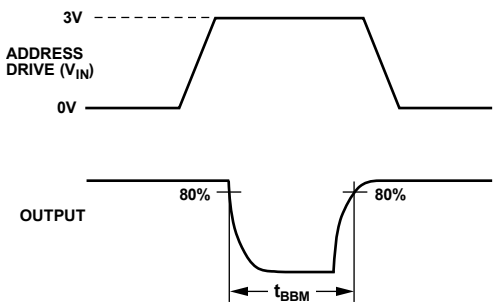
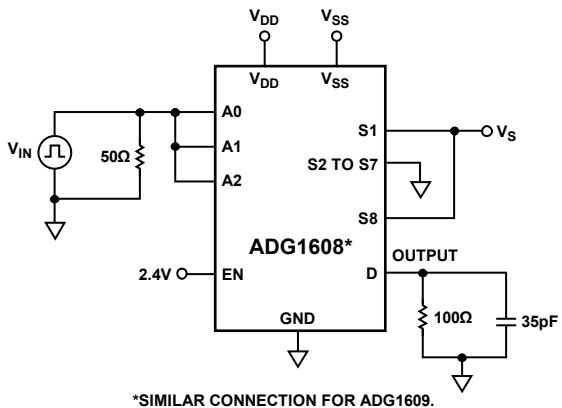


Figure 29. Break-Before-Make Delay, t_{BBM}



*SIMILAR CONNECTION FOR ADG1609.

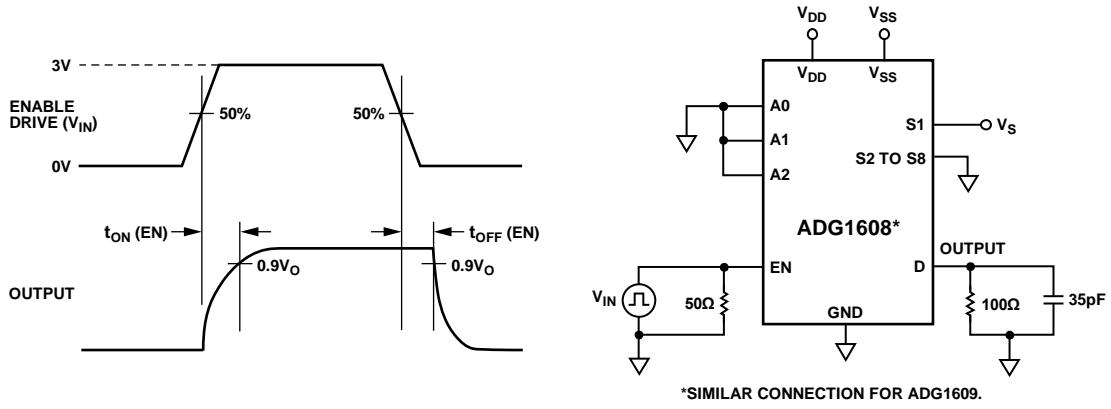


Figure 30. Enable Delay, $t_{ON}(EN)$, $t_{OFF}(EN)$

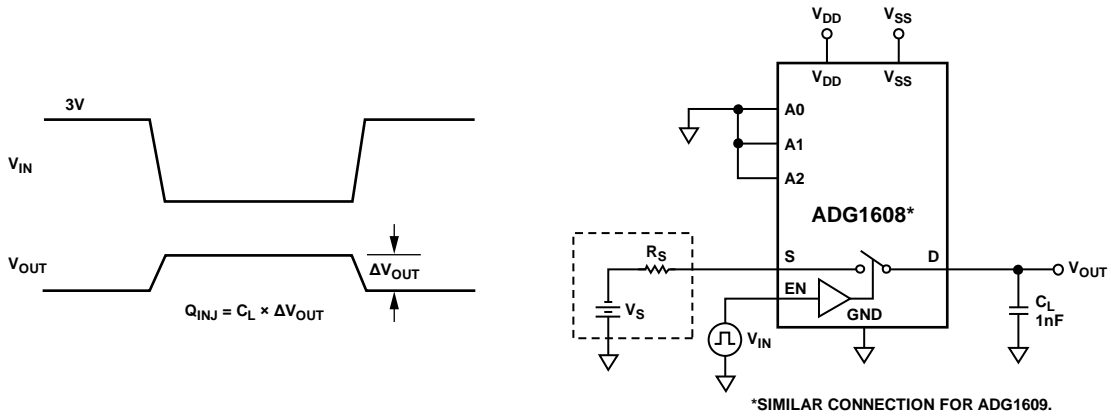


Figure 31. Charge Injection

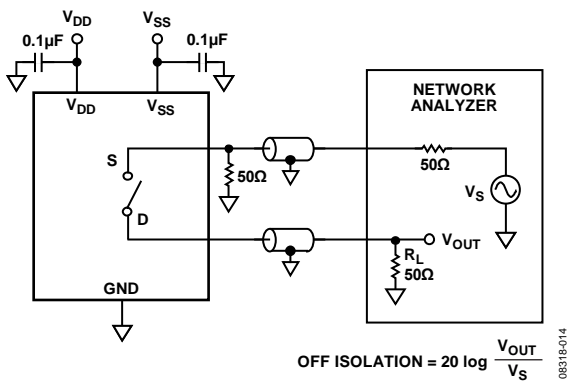


Figure 32. Off Isolation

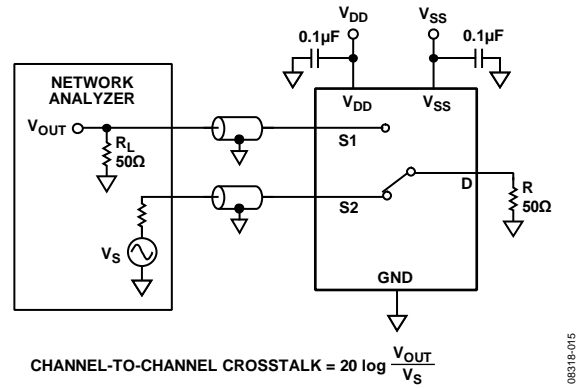


Figure 34. Channel-to-Channel Crosstalk

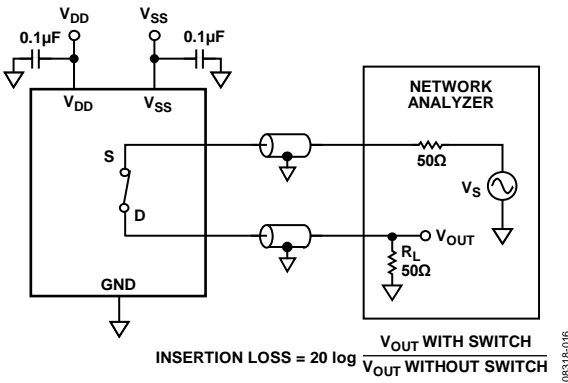


Figure 33. Bandwidth

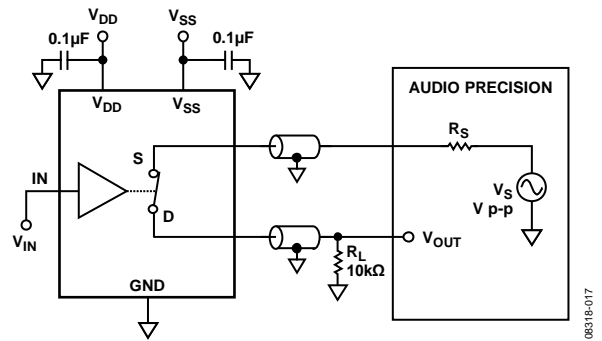


Figure 35. THD + Noise

TERMINOLOGY

I_{DD}

The positive supply current.

I_{SS}

The negative supply current.

V_D (V_S)

The analog voltage on Terminal D and Terminal S.

R_{ON}

The ohmic resistance between Terminal D and Terminal S.

R_{FLAT(ON)}

Flatness that is defined as the difference between the maximum and minimum value of on resistance measured over the specified analog signal range.

I_S (Off)

The source leakage current with the switch off.

I_D (Off)

The drain leakage current with the switch off.

I_D, I_S (On)

The channel leakage current with the switch on.

V_{INL}

The maximum input voltage for Logic 0.

V_{INH}

The minimum input voltage for Logic 1.

I_{INL} (I_{INH})

The input current of the digital input.

C_S (Off)

The off switch source capacitance, which is measured with reference to ground.

C_D (Off)

The off switch drain capacitance, which is measured with reference to ground.

C_D, C_S (On)

The on switch capacitance, which is measured with reference to ground.

C_{IN}

The digital input capacitance.

t_{TRANSITION}

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

t_{ON} (EN)

The delay between applying the digital control input and the output switching on.

t_{OFF} (EN)

The delay between applying the digital control input and the output switching off.

Charge Injection

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

Off Isolation

A measure of unwanted signal coupling through an off switch.

Crosstalk

A measure of unwanted signal that is coupled through from one channel to another as a result of parasitic capacitance.

Bandwidth

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

On Response

The frequency response of the on switch.

Insertion Loss

The loss due to the on resistance of the switch.

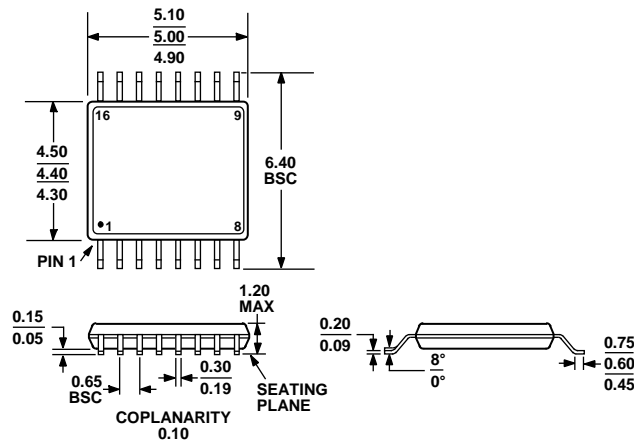
Total Harmonic Distortion + Noise (THD + N)

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

AC Power Supply Rejection Ratio (ACPSRR)

The ratio of the amplitude of signal on the output to the amplitude of the modulation. This is a measure of the ability of the part to avoid coupling noise and spurious signals that appear on the supply voltage pin to the output of the switch. The dc voltage on the device is modulated by a sine wave of 0.62 V p-p.

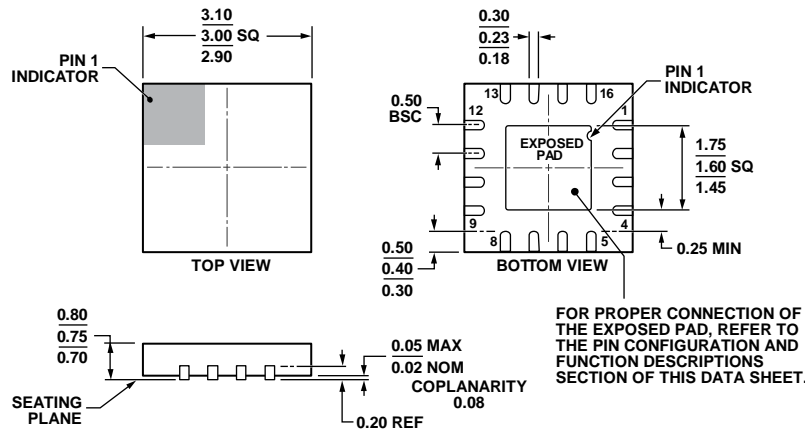
OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AB

Figure 36. 16-Lead Thin Shrink Small Outline Package [TSSOP] (RU-16)

Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-220-WEED-6.

Figure 37. 16-Lead Lead Frame Chip Scale Package [LF CSP_WQ] 3 mm x 3 mm Body, Very Very Thin Quad (CP-16-22)

Dimensions shown in millimeters

ORDERING GUIDE

| Model ¹ | Temperature Range | Package Description | Package Option | Branding |
|--------------------|-------------------|---|----------------|----------|
| ADG1608BRUZ | -40°C to +125°C | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16 | |
| ADG1608BRUZ-REEL7 | -40°C to +125°C | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16 | |
| ADG1608BCPZ-REEL7 | -40°C to +125°C | 16-Lead Lead Frame Chip Scale Package [LF CSP_WQ] | CP-16-22 | S38 |
| ADG1609BRUZ | -40°C to +125°C | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16 | |
| ADG1609BRUZ-REEL7 | -40°C to +125°C | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16 | |
| ADG1609BCPZ-REEL7 | -40°C to +125°C | 16-Lead Lead Frame Chip Scale Package [LF CSP_WQ] | CP-16-22 | S39 |

¹ Z = RoHS Compliant Part.

NOTES

NOTES

Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

 [View ADG1609BRUZ on WIN SOURCE](#)

 [Analog Devices Inc. Information](#)

Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management