



# 3 V/5 V, 4/8 Channel High Performance Analog Multiplexers

## ADG608/ADG609

### FEATURES

**+3 V, +5 V,  $\pm 5$  V Power Supplies**  
 **$V_{SS}$  to  $V_{DD}$  Analog Signal Range**  
**Low On Resistance (30  $\Omega$  max)**  
**Fast Switching Times**  
 $t_{ON}$  75 ns max  
 $t_{OFF}$  45 ns max  
**Low Power Dissipation (1.5  $\mu$ W max)**  
**Break-Before-Make Construction**  
**ESD > 5000 V as per Military Standard 3015.7**  
**TTL and CMOS Compatible Inputs**

### APPLICATIONS

**Automatic Test Equipment**  
**Data Acquisition Systems**  
**Communication Systems**  
**Avionics and Military Systems**  
**Microprocessor Controlled Analog Systems**  
**Medical Instrumentation**  
**Battery Powered Instruments**  
**Remote Powered Equipment**  
**Compatible with  $\pm 5$  V DACs and ADCs such as AD7840/8, AD7870/1/2/4/5/6/8**

### GENERAL DESCRIPTION

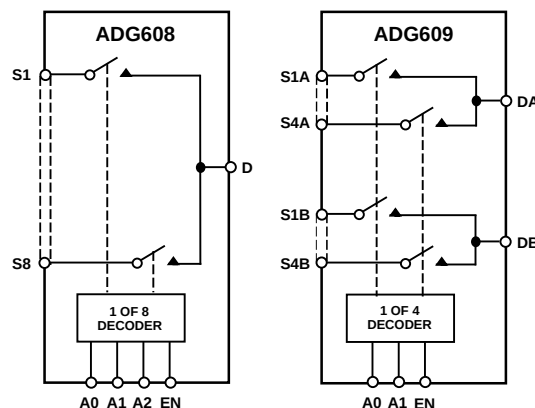
The ADG608 and ADG609 are monolithic CMOS analog multiplexers comprising eight single channels and four differential channels respectively, fully specified for  $\pm 5$  V, +5 V and +3 V power supplies. The ADG608 switches one of eight inputs to a common output as determined by the 3-bit binary address lines A0, A1 and A2. The ADG609 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. All the address and enable inputs are TTL compatible over the full specified operating temperature range, making the parts suitable for bus-controlled systems such as data acquisition systems, process controls, avionics and ATEs since the TTL compatible address inputs simplify the digital interface design and reduce the board space requirements.

The ADG608/ADG609 are designed on an enhanced LC<sup>2</sup>MOS process that provides low power dissipation yet gives high switching speed and low on resistance. Each channel conducts equally well in both directions when ON and has an input signal range which extends to the supplies. In the OFF condition, signal levels up to the supplies are blocked. All channels exhibit break-before-make switching action preventing momentary shorting when switching channels. Inherent in the design is low charge injection for minimum transients when switching the digital inputs.

### REV. A

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### FUNCTIONAL BLOCK DIAGRAMS



The ability to operate from single +3 V, +5 V or  $\pm 5$  V bipolar supplies makes the ADG608 and ADG609 perfect for use in battery operated instruments and with the new generation of DACs and ADCs from Analog Devices. The use of 5 V supplies and reduced operating currents gives much lower power dissipation than devices operating from  $\pm 15$  V supplies.

### PRODUCT HIGHLIGHTS

1. Extended Signal Range  
The ADG608/ADG609 are fabricated on an enhanced LC<sup>2</sup>MOS process giving an increased signal range which extends to the supplies.
2. Low Power Dissipation
3. Low  $R_{ON}$
4. Fast Switching Times
5. Break-Before-Make Switching  
Switches are guaranteed break-before-make so that input signals are protected against momentary shorting.
6. Single/Dual Supply Operation

### ORDERING GUIDE

| Model     | Temperature Range | Package Option* |
|-----------|-------------------|-----------------|
| ADG608BN  | -40°C to +85°C    | N-16            |
| ADG608BR  | -40°C to +85°C    | R-16A           |
| ADG608BRU | -40°C to +85°C    | RU-16           |
| ADG608TRU | -55°C to +125°C   | RU-16           |
| ADG609BN  | -40°C to +85°C    | N-16            |
| ADG609BR  | -40°C to +85°C    | R-16A           |
| ADG609BRU | -40°C to +85°C    | RU-16           |

\*N = Plastic DIP; RU = Thin Shrink Small Outline Package (TSSOP);  
R = 0.15" Small Outline IC (SOIC).

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One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.  
Tel: 617/329-4700 Fax: 617/326-8703

# ADG608/ADG609—SPECIFICATIONS

DUAL SUPPLY<sup>1</sup> ( $V_{DD} = +5\text{ V} \pm 10\%$ ,  $V_{SS} = -5\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ , unless otherwise noted)

| Parameter                                               | B Version<br>+25°C    -40°C to +85°C |                                    | T Version<br>+25°C    -55°C to +125°C |                                    | Units            | Test Conditions/<br>Comments                                                                                                                                                                                 |
|---------------------------------------------------------|--------------------------------------|------------------------------------|---------------------------------------|------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                    |                                      |                                    |                                       |                                    |                  |                                                                                                                                                                                                              |
| Analog Signal Range                                     |                                      | V <sub>SS</sub> to V <sub>DD</sub> |                                       | V <sub>SS</sub> to V <sub>DD</sub> | V                |                                                                                                                                                                                                              |
| R <sub>ON</sub>                                         | 22<br>30                             |                                    | 22<br>30                              |                                    | Ω typ<br>Ω max   | -3.5 V ≤ V <sub>S</sub> ≤ +3.5 V, I <sub>S</sub> = -1 mA;<br>V <sub>DD</sub> = +4.5 V, V <sub>SS</sub> = -4.5 V;<br>Test Circuit 1                                                                           |
| ΔR <sub>ON</sub>                                        | 5                                    | 6                                  | 5                                     | 6                                  | Ω max            |                                                                                                                                                                                                              |
| R <sub>ON</sub> Match                                   | 2                                    | 3                                  | 2                                     | 3                                  | Ω max            | -3 V ≤ V <sub>S</sub> ≤ +3 V, I <sub>DS</sub> = -1 mA;<br>V <sub>DD</sub> = +5 V, V <sub>SS</sub> = -5 V<br>V <sub>S</sub> = 0 V, I <sub>DS</sub> = -1 mA;<br>V <sub>DD</sub> = +5 V, V <sub>SS</sub> = -5 V |
| <b>LEAKAGE CURRENTS</b>                                 |                                      |                                    |                                       |                                    |                  |                                                                                                                                                                                                              |
| Source OFF Leakage I <sub>S</sub> (OFF)                 | ±0.05<br>±0.5                        |                                    | ±0.05<br>±0.5                         |                                    | nA typ<br>nA max | V <sub>DD</sub> = +5.5 V, V <sub>SS</sub> = -5.5 V<br>V <sub>D</sub> = ±4.5 V, V <sub>S</sub> = ∓4.5 V;<br>Test Circuit 2                                                                                    |
| Drain OFF Leakage I <sub>D</sub> (OFF)                  | ±0.05<br>±0.5                        |                                    | ±0.05<br>±0.5                         |                                    | nA typ<br>nA max | V <sub>D</sub> = ±4.5 V, V <sub>S</sub> = ∓4.5 V;<br>Test Circuit 3                                                                                                                                          |
| ADG608                                                  | ±0.5                                 | ±2                                 | ±0.5                                  | ±10                                | nA max           |                                                                                                                                                                                                              |
| ADG609                                                  | ±0.5                                 | ±1                                 | ±0.5                                  | ±5                                 | nA max           |                                                                                                                                                                                                              |
| Channel ON Leakage I <sub>D</sub> , I <sub>S</sub> (ON) | ±0.05<br>±0.5                        |                                    | ±0.05<br>±0.5                         |                                    | nA typ<br>nA max | V <sub>S</sub> = V <sub>D</sub> = ±4.5 V;<br>Test Circuit 4                                                                                                                                                  |
| ADG608                                                  | ±0.5                                 | ±3                                 | ±0.5                                  | ±20                                | nA max           |                                                                                                                                                                                                              |
| ADG609                                                  | ±0.5                                 | ±1.5                               | ±0.5                                  | ±10                                | nA max           |                                                                                                                                                                                                              |
| <b>DIGITAL INPUTS</b>                                   |                                      |                                    |                                       |                                    |                  |                                                                                                                                                                                                              |
| Input High Voltage, V <sub>INH</sub>                    |                                      | 2.4                                |                                       | 2.4                                | V min            |                                                                                                                                                                                                              |
| Input Low Voltage, V <sub>INL</sub>                     |                                      | 0.8                                |                                       | 0.8                                | V max            |                                                                                                                                                                                                              |
| Input Current                                           |                                      |                                    |                                       |                                    |                  | V <sub>IN</sub> = 0 or V <sub>DD</sub>                                                                                                                                                                       |
| I <sub>INL</sub> or I <sub>INH</sub>                    |                                      | ±1                                 |                                       | ±1                                 | μA max           |                                                                                                                                                                                                              |
| C <sub>IN</sub> , Digital Input Capacitance             | 5                                    |                                    | 5                                     |                                    | pF typ           |                                                                                                                                                                                                              |
| <b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>              |                                      |                                    |                                       |                                    |                  |                                                                                                                                                                                                              |
| t <sub>TRANSITION</sub>                                 | 50<br>75                             |                                    | 50<br>75                              |                                    | ns typ<br>ns max | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;<br>V <sub>S1</sub> = ±3.5 V, V <sub>S8</sub> = ∓3.5 V;<br>Test Circuit 5                                                                                     |
|                                                         |                                      | 90                                 |                                       | 100                                |                  |                                                                                                                                                                                                              |
| t <sub>OPEN</sub>                                       | 10                                   |                                    | 10                                    |                                    | ns min           | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;<br>V <sub>S</sub> = +3.5 V; Test Circuit 6                                                                                                                   |
| t <sub>ON</sub> (EN)                                    | 50<br>75                             |                                    | 50<br>75                              |                                    | ns typ<br>ns max | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;<br>V <sub>S</sub> = +3.5 V; Test Circuit 7                                                                                                                   |
|                                                         |                                      | 90                                 |                                       | 100                                |                  |                                                                                                                                                                                                              |
| t <sub>OFF</sub> (EN)                                   | 30<br>45                             |                                    | 30<br>45                              |                                    | ns typ<br>ns max | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;<br>V <sub>S</sub> = +3.5 V; Test Circuit 7                                                                                                                   |
|                                                         |                                      | 60                                 |                                       | 75                                 |                  |                                                                                                                                                                                                              |
| Charge Injection                                        | 6                                    |                                    | 6                                     |                                    | pC typ           | V <sub>S</sub> = 0 V, R <sub>S</sub> = 0 Ω, C <sub>L</sub> = 1 nF;<br>Test Circuit 8                                                                                                                         |
| OFF Isolation                                           | 85                                   |                                    | 85                                    |                                    | dB typ           | R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 15 pF, f = 100 kHz;<br>V <sub>S</sub> = 3 V rms; Test Circuit 9                                                                                                      |
| Channel-to-Channel Crosstalk                            | 85                                   |                                    | 85                                    |                                    | dB typ           | R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 15 pF, f = 100 kHz;<br>Test Circuit 10                                                                                                                               |
| C <sub>S</sub> (OFF)                                    | 9                                    |                                    | 9                                     |                                    | pF typ           |                                                                                                                                                                                                              |
| C <sub>D</sub> (OFF)                                    |                                      |                                    |                                       |                                    |                  |                                                                                                                                                                                                              |
| ADG608                                                  | 40                                   |                                    | 40                                    |                                    | pF typ           |                                                                                                                                                                                                              |
| ADG609                                                  | 20                                   |                                    | 20                                    |                                    | pF typ           |                                                                                                                                                                                                              |
| C <sub>D</sub> (ON)                                     |                                      |                                    |                                       |                                    |                  |                                                                                                                                                                                                              |
| ADG608                                                  | 54                                   |                                    | 54                                    |                                    | pF typ           |                                                                                                                                                                                                              |
| ADG609                                                  | 34                                   |                                    | 34                                    |                                    | pF typ           |                                                                                                                                                                                                              |
| <b>POWER REQUIREMENTS</b>                               |                                      |                                    |                                       |                                    |                  |                                                                                                                                                                                                              |
| I <sub>DD</sub>                                         | 0.05<br>0.2                          | 0.2<br>2                           | 0.05<br>0.2                           | 0.2<br>2                           | μA typ<br>μA max | V <sub>IN</sub> = 0 V or V <sub>DD</sub>                                                                                                                                                                     |
|                                                         |                                      |                                    |                                       |                                    |                  |                                                                                                                                                                                                              |
| I <sub>SS</sub>                                         | 0.01<br>0.1                          | 0.1<br>1                           | 0.01<br>0.1                           | 0.1<br>1                           | μA typ<br>μA max |                                                                                                                                                                                                              |

## NOTES

<sup>1</sup>Temperature ranges are as follows: B Version: -40°C to +85°C; T Version: -55°C to +125°C.

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

Specifications subject to change without notice.

# SINGLE SUPPLY<sup>1</sup> ( $V_{DD} = +5\text{ V} \pm 10\%$ , $V_{SS} = 0\text{ V}$ , $GND = 0\text{ V}$ , unless otherwise noted)

| Parameter                                               | B Version<br>+25°C      −40°C to<br>+85°C |          | T Version<br>+25°C      −55°C to<br>+125°C |          | Units            | Test Conditions/<br>Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                          |
|---------------------------------------------------------|-------------------------------------------|----------|--------------------------------------------|----------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| ANALOG SWITCH                                           |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| Analog Signal Range                                     | 0 to V <sub>DD</sub>                      |          | 0 to V <sub>DD</sub>                       |          | V                | V <sub>S</sub> = +3.5 V, I <sub>S</sub> = −1 mA;<br>V <sub>DD</sub> = +4.5 V;<br>Test Circuit 1<br>+1 V ≤ V <sub>S</sub> ≤ +3 V, I <sub>DS</sub> = −1 mA;<br>V <sub>DD</sub> = +5 V<br>V <sub>S</sub> = 0 V, I <sub>DS</sub> = −1 mA;<br>V <sub>DD</sub> = +5 V                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| R <sub>ON</sub>                                         | 40<br>50                                  | 60       | 40<br>50                                   | 70       | Ω typ<br>Ω max   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| ΔR <sub>ON</sub>                                        | 5                                         | 6        | 5                                          | 6        | Ω max            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| R <sub>ON</sub> Match                                   | 2                                         | 3        | 2                                          | 3        | Ω max            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
|                                                         |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| LEAKAGE CURRENTS                                        |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| Source OFF Leakage I <sub>S</sub> (OFF)                 | ±0.05<br>±0.5                             | ±2       | ±0.05<br>±0.5                              | ±10      | nA typ<br>nA max | V <sub>DD</sub> = +5.5 V<br>V <sub>D</sub> = 4.5 V/0.1 V, V <sub>S</sub> = 0.1 V/4.5 V;<br>Test Circuit 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                          |
| Drain OFF Leakage I <sub>D</sub> (OFF)                  | ±0.05                                     |          | ±0.05                                      |          | nA typ           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| ADG608                                                  | ±0.5                                      | ±2       | ±0.5                                       | ±10      | nA max           | V <sub>D</sub> = 4.5 V/0.1 V, V <sub>S</sub> = 0.1 V/4.5 V;<br>Test Circuit 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                          |
| ADG609                                                  | ±0.5                                      | ±1       | ±0.5                                       | ±5       | nA max           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| Channel ON Leakage I <sub>D</sub> , I <sub>S</sub> (ON) | ±0.05                                     |          | ±0.05                                      |          | nA typ           | V <sub>S</sub> = V <sub>D</sub> = 4.5 V/0.1 V;<br>Test Circuit 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          |
| ADG608                                                  | ±0.5                                      | ±3       | ±0.5                                       | ±20      | nA max           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| ADG609                                                  | ±0.5                                      | ±1.5     | ±0.5                                       | ±10      | nA max           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
|                                                         |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| DIGITAL INPUTS                                          |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| Input High Voltage, V <sub>INH</sub>                    | 2.4                                       |          | 2.4                                        |          | V min            | V <sub>IN</sub> = 0 or V <sub>DD</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                          |
| Input Low Voltage, V <sub>INL</sub>                     | 0.8                                       |          | 0.8                                        |          | V max            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| Input Current                                           |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| I <sub>INL</sub> or I <sub>INH</sub>                    | ±1                                        |          | ±1                                         |          | μA max           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| C <sub>IN</sub> , Digital Input Capacitance             | 5                                         |          | 5                                          |          | pF typ           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
|                                                         |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| DYNAMIC CHARACTERISTICS <sup>2</sup>                    |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| t <sub>TRANSITION</sub>                                 | 80<br>100                                 | 130      | 80<br>100                                  | 150      | ns typ<br>ns max | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;<br>V <sub>S1</sub> = 3.5 V/0 V, V <sub>S8</sub> = 0 V/3.5 V;<br>Test Circuit 5<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;<br>V <sub>S</sub> = +3.5 V; Test Circuit 6<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;<br>V <sub>S</sub> = +3.5 V; Test Circuit 7<br>R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;<br>V <sub>S</sub> = +3.5 V; Test Circuit 7<br>V <sub>S</sub> = 0 V, R <sub>S</sub> = 0 Ω, C <sub>L</sub> = 1 nF;<br>Test Circuit 8<br>R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 15 pF, f = 100 kHz;<br>V <sub>S</sub> = 1.5 V rms; Test Circuit 9<br>R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 15 pF, f = 100 kHz;<br>Test Circuit 10 |                                          |
| t <sub>OPEN</sub>                                       | 10                                        |          | 10                                         |          | ns min           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| t <sub>ON</sub> (EN)                                    | 80<br>100                                 | 130      | 80<br>100                                  | 150      | ns typ<br>ns max |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| t <sub>OFF</sub> (EN)                                   | 40<br>50                                  | 60       | 40<br>50                                   | 75       | ns typ<br>ns max |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| Charge Injection                                        | 0.5<br>3                                  |          | 0.5<br>3                                   |          | pC typ<br>pC max |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| OFF Isolation                                           | 85                                        |          | 85                                         |          | dB typ           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| Channel-to-Channel Crosstalk                            | 85                                        |          | 85                                         |          | dB typ           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| C <sub>S</sub> (OFF)                                    | 9                                         |          | 9                                          |          | pF typ           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| C <sub>D</sub> (OFF)                                    |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| ADG608                                                  | 40                                        |          | 40                                         |          | pF typ           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| ADG609                                                  | 20                                        |          | 20                                         |          | pF typ           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| C <sub>D</sub> (ON)                                     |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| ADG608                                                  | 54                                        |          | 54                                         |          | pF typ           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| ADG609                                                  | 34                                        |          | 34                                         |          | pF typ           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
|                                                         |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| POWER REQUIREMENTS                                      |                                           |          |                                            |          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                          |
| I <sub>DD</sub>                                         | 0.05<br>0.2                               | 0.2<br>2 | 0.05<br>0.2                                | 0.2<br>2 | μA typ<br>μA max |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | V <sub>IN</sub> = 0 V or V <sub>DD</sub> |

## NOTES

<sup>1</sup>Temperature ranges are as follows: B Version:  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ ; T Version:  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ .

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

Specifications subject to change without notice.

# ADG608/ADG609—SPECIFICATIONS

## SINGLE SUPPLY<sup>1</sup> ( $V_{DD} = +3.3 \text{ V} \pm 10\%$ , $V_{SS} = 0 \text{ V}$ , $GND = 0 \text{ V}$ , unless otherwise noted)

| Parameter                                               | B Version<br>+25°C      –40°C to<br>+85°C |      | T Version<br>+25°C    –55°C to<br>+125°C |     | Units  | Test Conditions/<br>Comments                                            |
|---------------------------------------------------------|-------------------------------------------|------|------------------------------------------|-----|--------|-------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                    |                                           |      |                                          |     |        |                                                                         |
| Analog Signal Range                                     | 0 to V <sub>DD</sub>                      |      | 0 to V <sub>DD</sub>                     |     | V      |                                                                         |
| R <sub>ON</sub>                                         | 60                                        |      | 60                                       |     | Ω typ  | V <sub>S</sub> = +1.5 V, I <sub>S</sub> = –1 mA;                        |
|                                                         | 90                                        | 100  | 90                                       | 120 | Ω max  | V <sub>DD</sub> = +3 V; Test Circuit 1                                  |
| R <sub>ON</sub> Match                                   | 3                                         | 3    | 3                                        | 3   | Ω max  | V <sub>S</sub> = 0 V, I <sub>DS</sub> = –1 mA, V <sub>DD</sub> = +3.3 V |
| <b>LEAKAGE CURRENTS</b>                                 |                                           |      |                                          |     |        |                                                                         |
| Source OFF Leakage I <sub>S</sub> (OFF)                 | ±0.05                                     |      | ±0.05                                    |     | nA typ | V <sub>DD</sub> = +3.6 V                                                |
|                                                         | ±0.5                                      | ±2   | ±0.5                                     | ±10 | nA max | V <sub>D</sub> = 2.6 V/0.1 V, V <sub>S</sub> = 0.1 V/2.6 V;             |
| Drain OFF Leakage I <sub>D</sub> (OFF)                  | ±0.05                                     |      | ±0.05                                    |     | nA typ | Test Circuit 2                                                          |
| ADG608                                                  | ±0.5                                      | ±2   | ±0.5                                     | ±10 | nA max | V <sub>D</sub> = 2.6 V/0.1 V, V <sub>S</sub> = 0.1 V/2.6 V;             |
| ADG609                                                  | ±0.5                                      | ±1   | ±0.5                                     | ±5  | nA max | Test Circuit 3                                                          |
| Channel ON Leakage I <sub>D</sub> , I <sub>S</sub> (ON) | ±0.05                                     |      | ±0.05                                    |     | nA typ | V <sub>S</sub> = V <sub>D</sub> = 2.6 V/0.1 V;                          |
| ADG608                                                  | ±0.5                                      | ±3   | ±0.5                                     | ±20 | nA max | Test Circuit 4                                                          |
| ADG609                                                  | ±0.5                                      | ±1.5 | ±0.5                                     | ±10 | nA max |                                                                         |
| <b>DIGITAL INPUTS</b>                                   |                                           |      |                                          |     |        |                                                                         |
| Input High Voltage, V <sub>INH</sub>                    | 2.4                                       |      | 2.4                                      |     | V min  |                                                                         |
| Input Low Voltage, V <sub>INL</sub>                     | 0.8                                       |      | 0.8                                      |     | V max  |                                                                         |
| Input Current                                           |                                           |      |                                          |     |        |                                                                         |
| I <sub>INL</sub> or I <sub>INH</sub>                    | ±1                                        |      | ±1                                       |     | μA max | V <sub>IN</sub> = 0 or V <sub>DD</sub>                                  |
| C <sub>IN</sub> , Digital Input Capacitance             | 5                                         |      | 5                                        |     | pF typ |                                                                         |
| <b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>              |                                           |      |                                          |     |        |                                                                         |
| t <sub>TRANSITION</sub>                                 | 120                                       |      | 120                                      |     | ns typ | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;                         |
|                                                         | 170                                       | 225  | 170                                      | 250 | ns max | V <sub>S1</sub> = 1.5 V/0 V, V <sub>S8</sub> = 0 V/1.5 V;               |
|                                                         |                                           |      |                                          |     |        | Test Circuit 5                                                          |
| t <sub>OPEN</sub>                                       | 10                                        |      | 10                                       |     | ns min | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;                         |
|                                                         |                                           |      |                                          |     |        | V <sub>S</sub> = +1.5 V; Test Circuit 6                                 |
| t <sub>ON</sub> (EN)                                    | 120                                       |      | 120                                      |     | ns typ | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;                         |
|                                                         | 170                                       | 225  | 170                                      | 250 | ns max | V <sub>S</sub> = +1.5 V; Test Circuit 7                                 |
| t <sub>OFF</sub> (EN)                                   | 40                                        |      | 40                                       |     | ns typ | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;                         |
|                                                         | 60                                        | 75   | 60                                       | 90  | ns max | V <sub>S</sub> = +1.5 V; Test Circuit 7                                 |
| Charge Injection                                        | 0.5                                       |      | 0.5                                      |     | pC typ | V <sub>S</sub> = 0 V, R <sub>S</sub> = 0 Ω, C <sub>L</sub> = 1 nF;      |
|                                                         | 3                                         |      | 3                                        |     | pC max | Test Circuit 8                                                          |
| OFF Isolation                                           | 85                                        |      | 85                                       |     | dB typ | R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 15 pF, f = 100 kHz;             |
|                                                         |                                           |      |                                          |     |        | V <sub>S</sub> = 1 V rms; Test Circuit 9                                |
| Channel-to-Channel Crosstalk                            | 85                                        |      | 85                                       |     | dB typ | R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 15 pF, f = 100 kHz;             |
|                                                         |                                           |      |                                          |     |        | Test Circuit 10                                                         |
| C <sub>S</sub> (OFF)                                    | 9                                         |      | 9                                        |     | pF typ |                                                                         |
| C <sub>D</sub> (OFF)                                    |                                           |      |                                          |     |        |                                                                         |
| ADG608                                                  | 40                                        |      | 40                                       |     | pF typ |                                                                         |
| ADG609                                                  | 20                                        |      | 20                                       |     | pF typ |                                                                         |
| C <sub>D</sub> (ON)                                     |                                           |      |                                          |     |        |                                                                         |
| ADG608                                                  | 54                                        |      | 54                                       |     | pF typ |                                                                         |
| ADG609                                                  | 34                                        |      | 34                                       |     | pF typ |                                                                         |
| <b>POWER REQUIREMENTS</b>                               |                                           |      |                                          |     |        |                                                                         |
| I <sub>DD</sub>                                         | 0.05                                      | 0.2  | 0.05                                     | 0.2 | μA typ | V <sub>IN</sub> = 0 V or V <sub>DD</sub>                                |
|                                                         | 0.2                                       | 2    | 0.2                                      | 2   | μA max |                                                                         |

### NOTES

<sup>1</sup>Temperature ranges are as follows: B Version: –40°C to +85°C; T Version: –55°C to +125°C.

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

Specifications subject to change without notice.

## ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

(T<sub>A</sub> = +25°C unless otherwise noted)

|                                      |                                                                     |
|--------------------------------------|---------------------------------------------------------------------|
| V <sub>DD</sub> to V <sub>SS</sub>   | +13 V                                                               |
| V <sub>DD</sub> to GND               | −0.3 V to +6.5 V                                                    |
| V <sub>SS</sub> to GND               | +0.3 V to −6.5 V                                                    |
| Analog, Digital Inputs <sup>2</sup>  | −0.3 V to V <sub>DD</sub> + 2 V<br>or 20 mA, Whichever Occurs First |
| Continuous Current, S or D           | 20 mA                                                               |
| Peak Current, S or D                 | 40 mA<br>(Pulsed at 1 ms, 10% Duty Cycle Max)                       |
| Operating Temperature Range          |                                                                     |
| Industrial (B Version)               | −40°C to +85°C                                                      |
| Extended (T Version)                 | −55°C to +125°C                                                     |
| Storage Temperature Range            | −65°C to +150°C                                                     |
| Junction Temperature                 | +150°C                                                              |
| Plastic DIP Package                  |                                                                     |
| θ <sub>JA</sub> , Thermal Impedance  | 117°C/W                                                             |
| Lead Temperature, Soldering (10 sec) | +260°C                                                              |

## SOIC Package

|                                     |        |
|-------------------------------------|--------|
| θ <sub>JA</sub> , Thermal Impedance | 77°C/W |
| Lead Temperature, Soldering         |        |
| Vapor Phase (60 sec)                | +215°C |
| Infrared (15 sec)                   | +220°C |

## TSSOP Package

|                                     |         |
|-------------------------------------|---------|
| θ <sub>JA</sub> , Thermal Impedance | 158°C/W |
| Lead Temperature, Soldering         |         |
| Vapor Phase (60 sec)                | +215°C  |
| Infrared (15 sec)                   | +220°C  |

ESD Rating >5000 V

## NOTES

<sup>1</sup>Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Only one absolute maximum rating may be applied at any one time.

<sup>2</sup>Overvoltages at A, S, D or EN will be clamped by internal diodes. Current should be limited to the maximum ratings given.

**Table I. ADG608 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         |

X = Don't Care

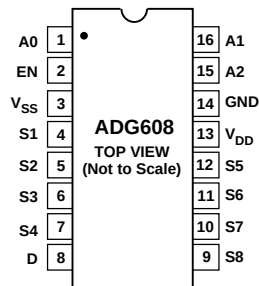
**Table II. ADG609 Truth Table**

| 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              |

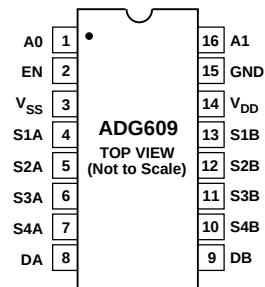
X = Don't Care

## PIN CONFIGURATIONS

### DIP/SOIC/TSSOP



### DIP/SOIC/TSSOP



# ADG608/ADG609—Typical Performance Characteristics

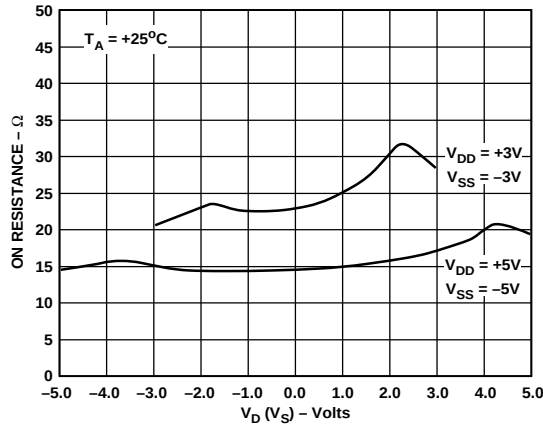


Figure 1.  $R_{ON}$  as a Function of  $V_D$  ( $V_S$ ): Dual Supply Voltage

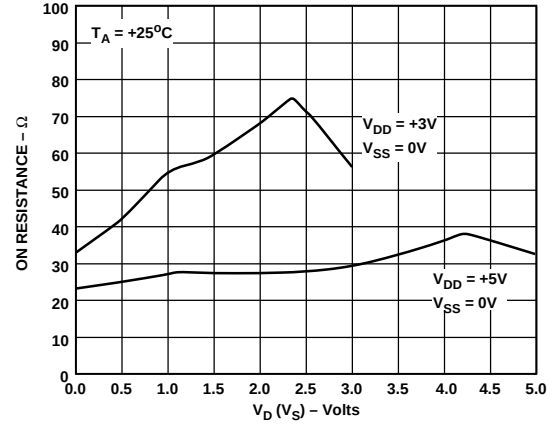


Figure 4.  $R_{ON}$  as a Function of  $V_D$  ( $V_S$ ): Single Supply Voltage

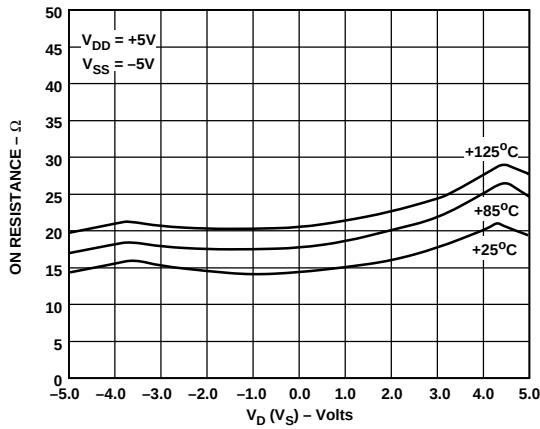


Figure 2.  $R_{ON}$  as a Function of  $V_D$  ( $V_S$ ) for Different Temperatures

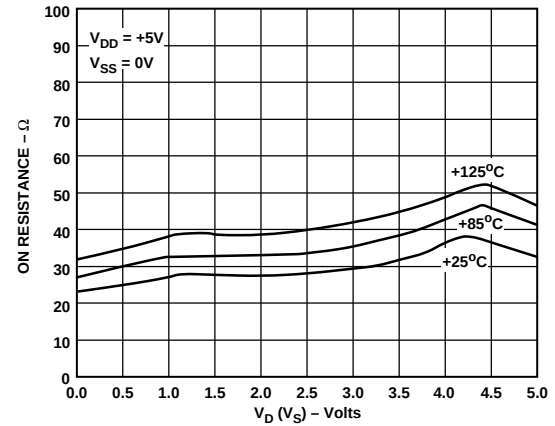


Figure 5.  $R_{ON}$  as a Function of  $V_D$  ( $V_S$ ) for Different Temperatures

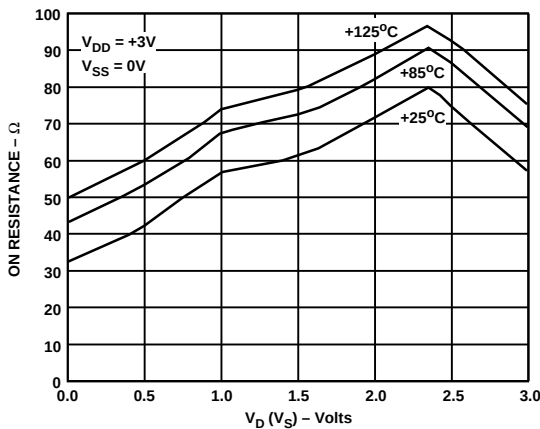


Figure 3.  $R_{ON}$  as a Function of  $V_D$  ( $V_S$ ) for Different Temperatures

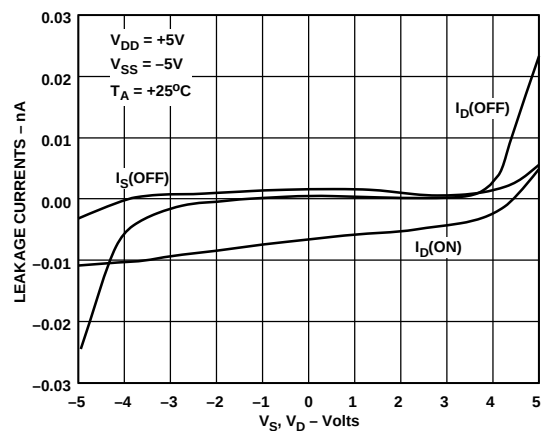


Figure 6. Leakage Currents as a Function of  $V_D$  ( $V_S$ )

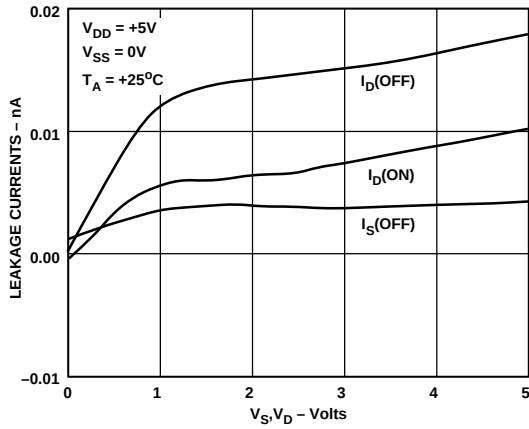


Figure 7. Leakage Currents as a Function of  $V_D$  ( $V_S$ )

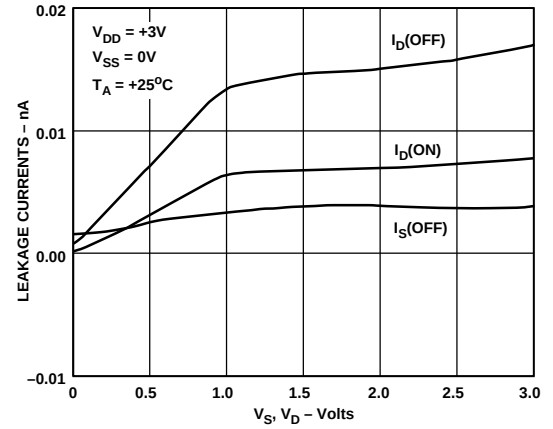


Figure 10. Leakage Currents as a Function of  $V_D$  ( $V_S$ )

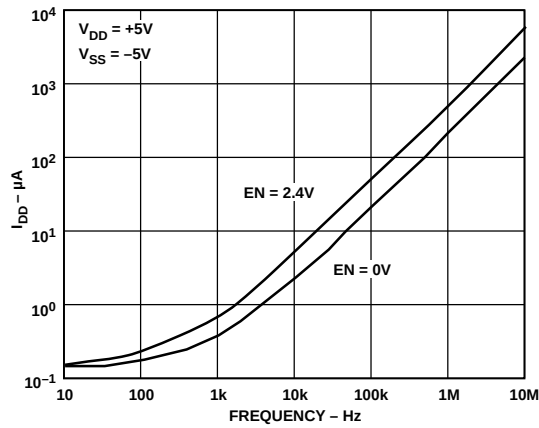


Figure 8. Positive Supply Current vs. Switching Frequency

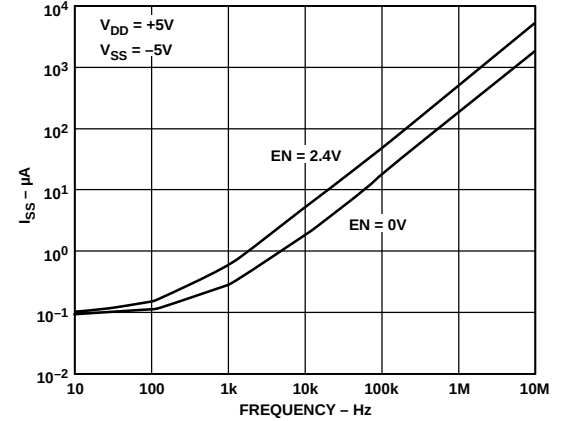


Figure 11. Negative Supply Current vs. Switching Frequency

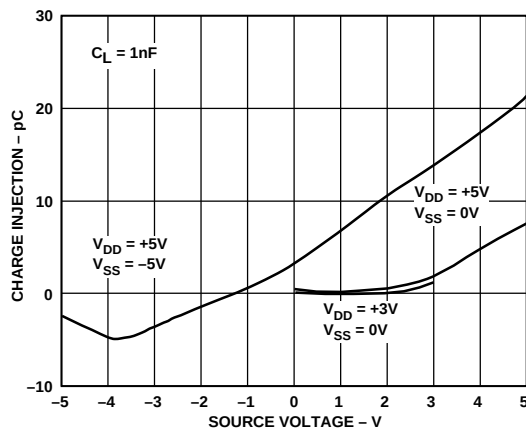


Figure 9. Charge Injection vs. Analog Voltage  $V_S$

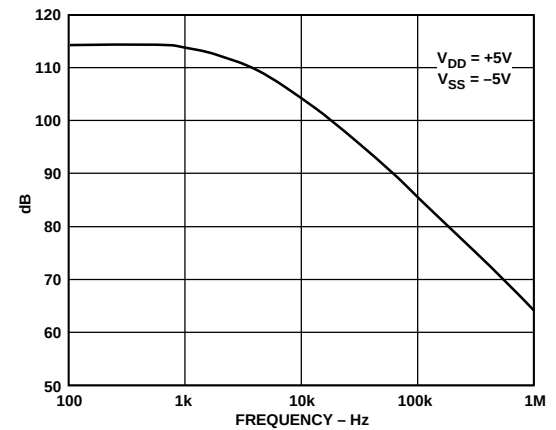
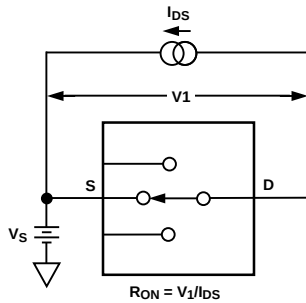


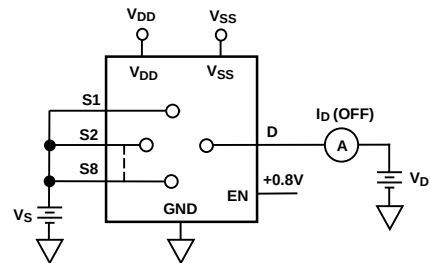
Figure 12. Crosstalk and Off Isolation vs. Frequency

# ADG608/ADG609

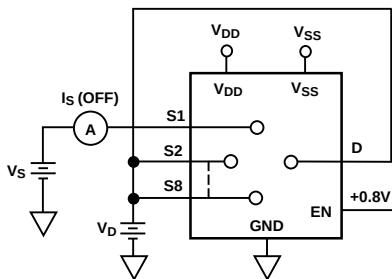
## Test Circuits



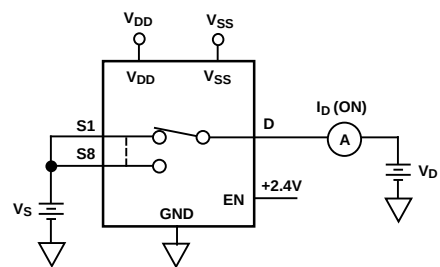
Test Circuit 1. On Resistance



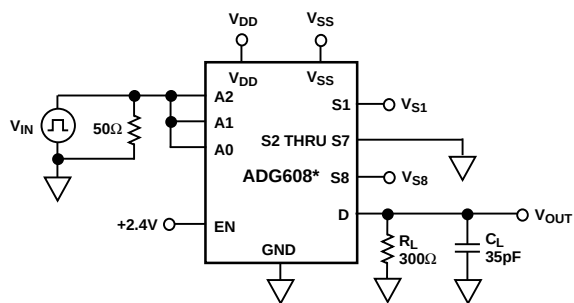
Test Circuit 3.  $I_D$  (OFF)



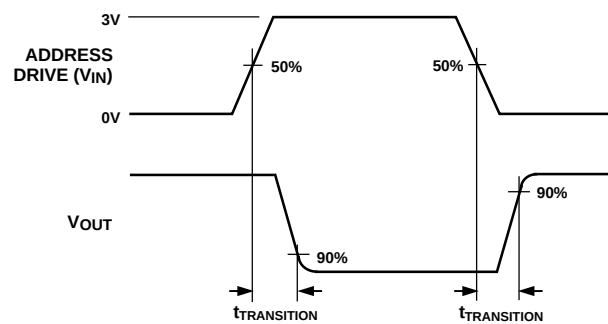
Test Circuit 2.  $I_S$  (OFF)



Test Circuit 4.  $I_D$  (ON)

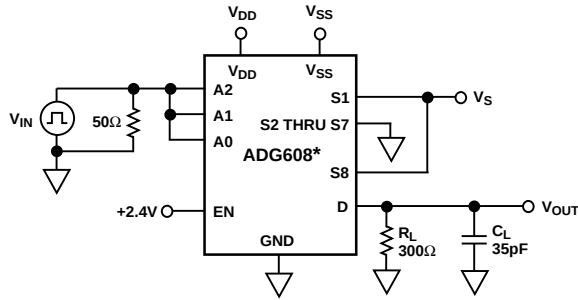


\* SIMILAR CONNECTION FOR ADG609

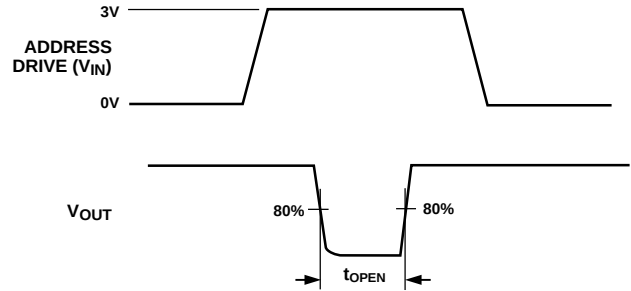


Test Circuit 5. Switching Time of Multiplexer,  $t_{TRANSITION}$

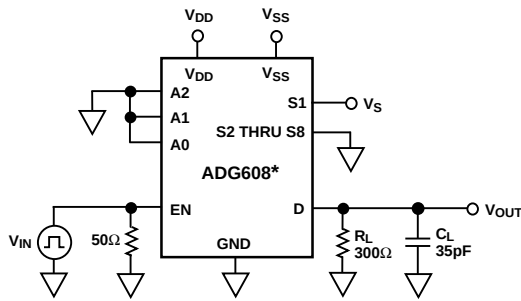




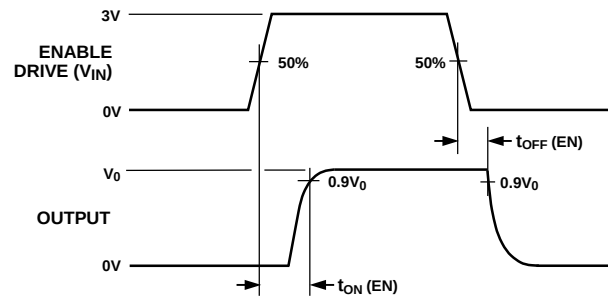
\* SIMILAR CONNECTION FOR ADG609



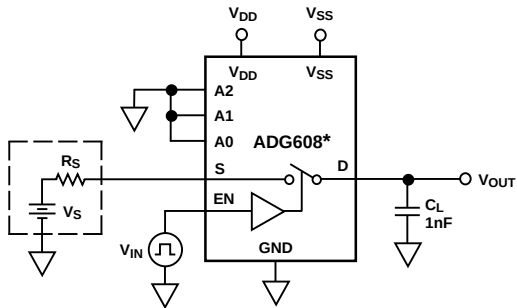
Test Circuit 6. Break-Before-Make Delay,  $t_{OPEN}$



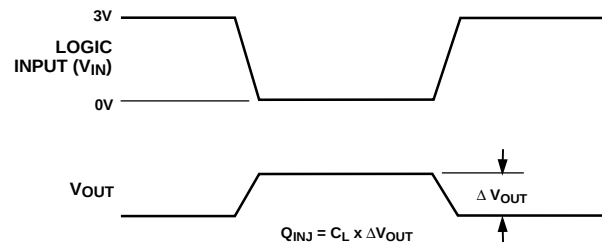
\* SIMILAR CONNECTION FOR ADG609



Test Circuit 7. Enable Delay,  $t_{ON} (EN)$ ,  $t_{OFF} (EN)$

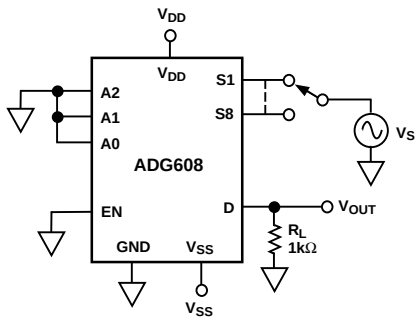


\* SIMILAR CONNECTION FOR ADG609

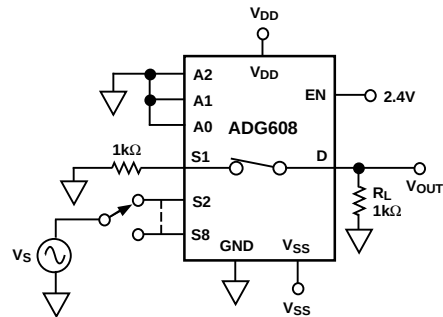


Test Circuit 8. Charge Injection

# ADG608/ADG609



Test Circuit 9. OFF Isolation



Test Circuit 10. Channel-to-Channel Crosstalk

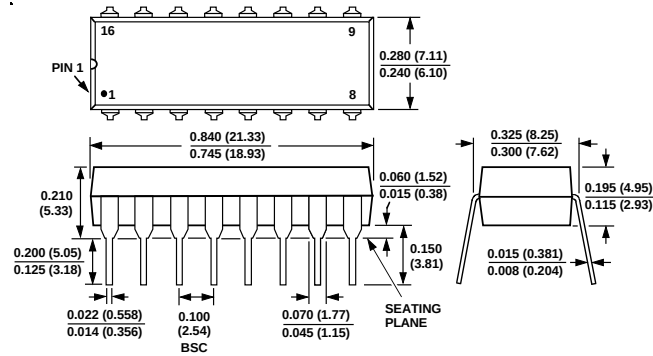
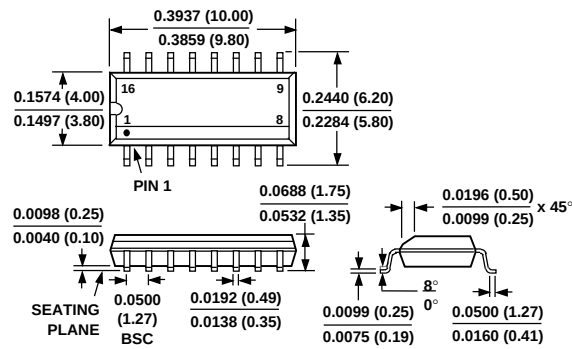
## TERMINOLOGY

|                 |                                                                                                                      |
|-----------------|----------------------------------------------------------------------------------------------------------------------|
| $V_{DD}$        | Most positive power supply potential.                                                                                |
| $V_{SS}$        | Most negative power supply potential in dual supplies. In single supply applications, it may be connected to ground. |
| GND             | Ground (0 V) reference.                                                                                              |
| $R_{ON}$        | Ohmic resistance between D and S.                                                                                    |
| $\Delta R_{ON}$ | $R_{ON}$ variation due to a change in the analog input voltage with a constant load current.                         |
| $R_{ON}$ Match  | Difference between the $R_{ON}$ of any two channels.                                                                 |
| $I_S$ (OFF)     | Source leakage current when the switch is off.                                                                       |
| $I_D$ (OFF)     | Drain leakage current when the switch is off.                                                                        |
| $I_D, I_S$ (ON) | Channel leakage current when the switch is on.                                                                       |
| $V_D, V_S$      | Analog voltage on terminals D, S.                                                                                    |
| $C_S$ (OFF)     | Channel input capacitance for “OFF” condition.                                                                       |
| $C_D$ (OFF)     | Channel output capacitance for “OFF” condition.                                                                      |
| $C_D, C_S$ (ON) | “ON” switch capacitance.                                                                                             |
| $C_{IN}$        | Digital input capacitance.                                                                                           |
| $t_{ON}$ (EN)   | Delay time between the 50% and 90% points of the digital input and switch “ON” condition.                            |

|                         |                                                                                                                                                 |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| $t_{OFF}$ (EN)          | Delay time between the 50% and 90% points of the digital input and switch “OFF” condition.                                                      |
| $t_{TRANSITION}$        | Delay time between the 50% and 90% points of the digital inputs and the switch “ON” condition when switching from one address state to another. |
| $t_{OPEN}$              | “OFF” time measured between the 80% points of both switches when switching from one address state to another.                                   |
| $V_{INL}$               | Maximum input voltage for logic “0.”                                                                                                            |
| $V_{INH}$               | Minimum input voltage for logic “1.”                                                                                                            |
| $I_{INL}$ ( $I_{INH}$ ) | Input current of the digital input.                                                                                                             |
| Crosstalk               | A measure of unwanted signal which is coupled through from one channel to another as a result of parasitic capacitance.                         |
| Off Isolation           | A measure of unwanted signal coupling through an “OFF” channel.                                                                                 |
| Charge Injection        | A measure of the glitch impulse transferred from the digital input to the analog output during switching.                                       |
| $I_{DD}$                | Positive supply current.                                                                                                                        |
| $I_{SS}$                | Negative supply current.                                                                                                                        |

**OUTLINE DIMENSIONS**

Dimensions shown in inches and (mm).

**16-Pin Plastic (N-16)****16-Pin SOIC (R-16A)****16-Pin TSSOP (RU-16)**