



# CMOS, +1.8 V to +5.5 V/ $\pm 2.5$ V, 2.5 $\Omega$ Low-Voltage, 8-/16-Channel Multiplexers

## ADG706/ADG707

### FEATURES

- +1.8 V to +5.5 V Single Supply
- $\pm 2.5$  V Dual Supply
- 2.5  $\Omega$  ON Resistance
- 0.5  $\Omega$  ON Resistance Flatness
- 100 pA Leakage Currents
- 40 ns Switching Times
- Single 16-to-1 Multiplexer ADG706
- Differential 8-to-1 Multiplexer ADG707
- 28-Lead TSSOP Package
- Low-Power Consumption
- TTL/CMOS-Compatible Inputs

### APPLICATIONS

- Data Acquisition Systems
- Communication Systems
- Relay Replacement
- Audio and Video Switching
- Battery-Powered Systems

### GENERAL DESCRIPTION

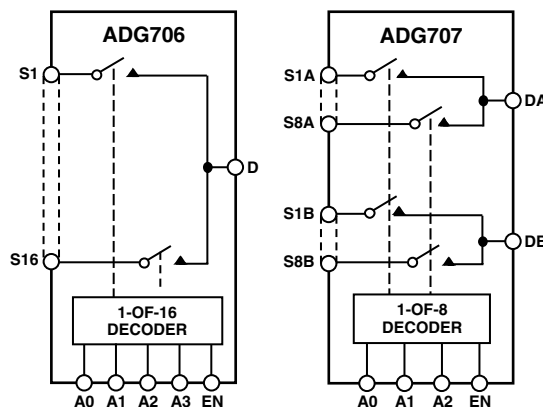
The ADG706 and ADG707 are low-voltage, CMOS analog multiplexers comprising 16 single channels and eight differential channels, respectively. The ADG706 switches one of 16 inputs (S1–S16) to a common output, D, as determined by the 4-bit binary address lines A0, A1, A2, and A3. The ADG707 switches one of eight differential inputs to a common differential output as determined by the 3-bit binary address lines A0, A1, and A2. An EN input on both devices is used to enable or disable the device. When disabled, all channels are switched OFF.

Low-power consumption and operating supply range of 1.8 V to 5.5 V make the ADG706 and ADG707 ideal for battery-powered, portable instruments. All channels exhibit break-before-make switching action preventing momentary shorting when switching channels. These devices are also designed to operate from a dual supply of  $\pm 2.5$  V.

These multiplexers are designed on an enhanced submicron process that provides low-power dissipation yet gives high switching speed, very low ON resistance, and leakage currents. ON resistance is in the region of a few ohms and is closely matched between switches and very flat over the full signal range. These parts can operate equally well as either multiplexers or demultiplexers and have an input signal range that extends to the supplies.

The ADG706 and ADG707 are available in small 28-lead TSSOP packages.

### FUNCTIONAL BLOCK DIAGRAMS



### PRODUCT HIGHLIGHTS

1. Single-/dual-supply operation. The ADG706 and ADG707 are fully specified and guaranteed with 3 V and 5 V single-supply and  $\pm 2.5$  V dual-supply rails.
2. Low ON resistance (2.5  $\Omega$  typical)
3. Low-power consumption ( $< 0.01$   $\mu$ W)
4. Guaranteed break-before-make switching action
5. Small 28-lead TSSOP package

### REV. B

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# ADG706/ADG707—SPECIFICATIONS<sup>1</sup> (V<sub>DD</sub> = 5 V ± 10%, V<sub>SS</sub> = 0 V, GND = 0 V, unless otherwise noted.)

| Parameter                                                | 25°C  | –40°C<br>to +85°C      | Unit    | Test Conditions/Comments                                           |
|----------------------------------------------------------|-------|------------------------|---------|--------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                     |       |                        |         |                                                                    |
| Analog Signal Range                                      |       | 0 V to V <sub>DD</sub> | V       |                                                                    |
| ON Resistance (R <sub>ON</sub> )                         | 2.5   |                        | Ω typ   | V <sub>S</sub> = 0 V to V <sub>DD</sub> , I <sub>DS</sub> = 10 mA; |
|                                                          | 4.5   | 5                      | Ω max   | Test Circuit 1                                                     |
| ON Resistance Match Between Channels (ΔR <sub>ON</sub> ) |       | 0.3                    | Ω typ   | V <sub>S</sub> = 0 V to V <sub>DD</sub> , I <sub>DS</sub> = 10 mA  |
|                                                          |       | 0.8                    | Ω max   |                                                                    |
| ON Resistance Flatness (R <sub>FLAT(ON)</sub> )          | 0.5   |                        | Ω typ   | V <sub>S</sub> = 0 V to V <sub>DD</sub> , I <sub>DS</sub> = 10 mA  |
|                                                          |       | 1.2                    | Ω max   |                                                                    |
| <b>LEAKAGE CURRENTS</b>                                  |       |                        |         |                                                                    |
| Source OFF Leakage I <sub>S</sub> (OFF)                  | ±0.01 |                        | nA typ  | V <sub>DD</sub> = 5.5 V                                            |
|                                                          | ±0.1  | ±0.3                   | nA max  | V <sub>D</sub> = 4.5 V/1 V, V <sub>S</sub> = 1 V/4.5 V;            |
| Drain OFF Leakage I <sub>D</sub> (OFF)                   | ±0.01 |                        | nA typ  | Test Circuit 2                                                     |
| ADG706                                                   | ±0.4  | ±1.5                   | nA max  | V <sub>D</sub> = 4.5 V/1 V, V <sub>S</sub> = 1 V/4.5 V;            |
| ADG707                                                   | ±0.2  | ±1                     | nA max  | Test Circuit 3                                                     |
| Channel ON Leakage I <sub>D</sub> , I <sub>S</sub> (ON)  | ±0.01 |                        | nA typ  | V <sub>D</sub> = V <sub>S</sub> = 1 V, or 4.5 V;                   |
| ADG706                                                   | ±0.4  | ±1.5                   | nA max  | Test Circuit 4                                                     |
| ADG707                                                   | ±0.2  | ±1                     | nA max  |                                                                    |
| <b>DIGITAL INPUTS</b>                                    |       |                        |         |                                                                    |
| Input High Voltage, V <sub>INH</sub>                     |       | 2.4                    | V min   |                                                                    |
| Input Low Voltage, V <sub>INL</sub>                      |       | 0.8                    | V max   |                                                                    |
| Input Current                                            |       |                        |         |                                                                    |
| I <sub>INL</sub> or I <sub>INH</sub>                     | 0.005 |                        | μA typ  | V <sub>IN</sub> = V <sub>INL</sub> or V <sub>INH</sub>             |
|                                                          |       | ±0.1                   | μA max  |                                                                    |
| C <sub>IN</sub> , Digital Input Capacitance              | 5     |                        | pF typ  |                                                                    |
| <b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>               |       |                        |         |                                                                    |
| t <sub>TRANSITION</sub>                                  | 40    |                        | ns typ  | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF, Test Circuit 5;    |
|                                                          |       | 60                     | ns max  | V <sub>S1</sub> = 3 V/0 V, V <sub>S16</sub> = 0 V/3 V              |
| Break-Before-Make Time Delay, t <sub>D</sub>             | 30    |                        | ns typ  | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;                    |
|                                                          |       | 1                      | ns min  | V <sub>S</sub> = 3 V, Test Circuit 6                               |
| t <sub>ON</sub> (EN)                                     | 32    |                        | ns typ  | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;                    |
|                                                          |       | 50                     | ns max  | V <sub>S</sub> = 3 V, Test Circuit 7                               |
| t <sub>OFF</sub> (EN)                                    | 10    |                        | ns typ  | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;                    |
|                                                          |       | 14                     | ns max  | V <sub>S</sub> = 3 V, Test Circuit 7                               |
| Charge Injection                                         | ±5    |                        | pC typ  | V <sub>S</sub> = 1 V, R <sub>S</sub> = 0 Ω, C <sub>L</sub> = 1 nF; |
|                                                          |       |                        |         | Test Circuit 8                                                     |
| OFF Isolation                                            | –60   |                        | dB typ  | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 10 MHz;          |
|                                                          | –80   |                        | dB typ  | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz;           |
|                                                          |       |                        |         | Test Circuit 9                                                     |
| Channel-to-Channel Crosstalk                             | –60   |                        | dB typ  | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 10 MHz;          |
|                                                          | –80   |                        | dB typ  | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz;           |
|                                                          |       |                        |         | Test Circuit 10                                                    |
| –3 dB Bandwidth                                          |       |                        |         |                                                                    |
| ADG706                                                   | 25    |                        | MHz typ | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, Test Circuit 9       |
| ADG707                                                   | 36    |                        | MHz typ | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, Test Circuit 9       |
| C <sub>S</sub> (OFF)                                     | 13    |                        | pF typ  | f = 1 MHz                                                          |
| C <sub>D</sub> (OFF)                                     |       |                        |         |                                                                    |
| ADG706                                                   | 180   |                        | pF typ  | f = 1 MHz                                                          |
| ADG707                                                   | 90    |                        | pF typ  | f = 1 MHz                                                          |
| C <sub>D</sub> , C <sub>S</sub> (ON)                     |       |                        |         |                                                                    |
| ADG706                                                   | 200   |                        | pF typ  | f = 1 MHz                                                          |
| ADG707                                                   | 100   |                        | pF typ  | f = 1 MHz                                                          |
| <b>POWER REQUIREMENTS</b>                                |       |                        |         |                                                                    |
| I <sub>DD</sub>                                          | 0.001 |                        | μA typ  | V <sub>DD</sub> = 5.5 V                                            |
|                                                          |       | 1.0                    | μA max  | Digital Inputs = 0 V or 5.5 V                                      |

## NOTES

<sup>1</sup>Temperature range is –40°C to +85°C.

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

Specifications subject to change without notice.

# SPECIFICATIONS<sup>1</sup> (V<sub>DD</sub> = 3 V ± 10%, V<sub>SS</sub> = 0 V, GND = 0 V, unless otherwise noted.)

ADG706/ADG707

| Parameter                                                   | 25°C          | –40°C<br>to +85°C      | Unit             | Test Conditions/Comments                                                                                                                 |
|-------------------------------------------------------------|---------------|------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                        |               |                        |                  |                                                                                                                                          |
| Analog Signal Range                                         |               | 0 V to V <sub>DD</sub> | V                |                                                                                                                                          |
| ON Resistance (R <sub>ON</sub> )                            | 6<br>11       | 12                     | Ω typ<br>Ω max   | V <sub>S</sub> = 0 V to V <sub>DD</sub> , I <sub>DS</sub> = 10 mA;<br>Test Circuit 1                                                     |
| ON Resistance Match Between<br>Channels (ΔR <sub>ON</sub> ) |               | 0.4<br>1.2             | Ω typ<br>Ω max   | V <sub>S</sub> = 0 V to V <sub>DD</sub> , I <sub>DS</sub> = 10 mA                                                                        |
| ON Resistance Flatness (R <sub>FLAT(ON)</sub> )             |               | 3                      | Ω typ            | V <sub>S</sub> = 0 V to V <sub>DD</sub> , I <sub>DS</sub> = 10 mA                                                                        |
| <b>LEAKAGE CURRENTS</b>                                     |               |                        |                  |                                                                                                                                          |
| Source OFF Leakage I <sub>S</sub> (OFF)                     | ±0.01<br>±0.1 | ±0.3                   | nA typ<br>nA max | V <sub>DD</sub> = 3.3 V<br>V <sub>S</sub> = 3 V/1 V, V <sub>D</sub> = 1 V/3 V;<br>Test Circuit 2                                         |
| Drain OFF Leakage I <sub>D</sub> (OFF)                      | ±0.01         |                        | nA typ           | V <sub>S</sub> = 3 V/1 V, V <sub>D</sub> = 1 V/3 V;<br>Test Circuit 3                                                                    |
| ADG706                                                      | ±0.4          | ±1.5                   | nA max           |                                                                                                                                          |
| ADG707                                                      | ±0.2          | ±1                     | nA max           |                                                                                                                                          |
| Channel ON Leakage I <sub>D</sub> , I <sub>S</sub> (ON)     | ±0.01         |                        | nA typ           | V <sub>S</sub> = V <sub>D</sub> = 1 V or 3 V;<br>Test Circuit 4                                                                          |
| ADG706                                                      | ±0.4          | ±1.5                   | nA max           |                                                                                                                                          |
| ADG707                                                      | ±0.2          | ±1                     | nA max           |                                                                                                                                          |
| <b>DIGITAL INPUTS</b>                                       |               |                        |                  |                                                                                                                                          |
| Input High Voltage, V <sub>INH</sub>                        |               | 2.0                    | V min            |                                                                                                                                          |
| Input Low Voltage, V <sub>INL</sub>                         |               | 0.8                    | V max            |                                                                                                                                          |
| Input Current                                               |               |                        |                  |                                                                                                                                          |
| I <sub>INL</sub> or I <sub>INH</sub>                        | 0.005         | ±0.1                   | μA typ<br>μA max | V <sub>IN</sub> = V <sub>INL</sub> or V <sub>INH</sub>                                                                                   |
| C <sub>IN</sub> , Digital Input Capacitance                 | 5             |                        | pF typ           |                                                                                                                                          |
| <b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>                  |               |                        |                  |                                                                                                                                          |
| t <sub>TRANSITION</sub>                                     | 45            | 75                     | ns typ<br>ns max | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF, Test Circuit 5<br>V <sub>S1</sub> = 2 V/0 V, V <sub>S16</sub> = 0 V/2 V                  |
| Break-Before-Make Time Delay, t <sub>D</sub>                | 30            | 1                      | ns typ<br>ns min | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;<br>V <sub>S</sub> = 2 V, Test Circuit 6                                                  |
| t <sub>ON</sub> (EN)                                        | 40            | 70                     | ns typ<br>ns max | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;<br>V <sub>S</sub> = 2 V, Test Circuit 7                                                  |
| t <sub>OFF</sub> (EN)                                       | 20            | 28                     | ns typ<br>ns max | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF;<br>V <sub>S</sub> = 2 V, Test Circuit 7                                                  |
| Charge Injection                                            | ±5            |                        | pC typ           | V <sub>S</sub> = 1 V, R <sub>S</sub> = 0 Ω, C <sub>L</sub> = 1 nF;<br>Test Circuit 8                                                     |
| OFF Isolation                                               | –60<br>–80    |                        | dB typ<br>dB typ | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 10 MHz;<br>R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz;<br>Test Circuit 9  |
| Channel-to-Channel Crosstalk                                | –60<br>–80    |                        | dB typ<br>dB typ | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 10 MHz;<br>R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz;<br>Test Circuit 10 |
| –3 dB Bandwidth                                             |               |                        |                  |                                                                                                                                          |
| ADG706                                                      | 25            |                        | MHz typ          | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, Test Circuit 9                                                                             |
| ADG707                                                      | 36            |                        | MHz typ          | R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, Test Circuit 9                                                                             |
| C <sub>S</sub> (OFF)                                        | 13            |                        | pF typ           | f = 1 MHz                                                                                                                                |
| C <sub>D</sub> (OFF)                                        |               |                        |                  |                                                                                                                                          |
| ADG706                                                      | 180           |                        | pF typ           | f = 1 MHz                                                                                                                                |
| ADG707                                                      | 90            |                        | pF typ           | f = 1 MHz                                                                                                                                |
| C <sub>D</sub> , C <sub>S</sub> (ON)                        |               |                        |                  |                                                                                                                                          |
| ADG706                                                      | 200           |                        | pF typ           | f = 1 MHz                                                                                                                                |
| ADG707                                                      | 100           |                        | pF typ           | f = 1 MHz                                                                                                                                |
| <b>POWER REQUIREMENTS</b>                                   |               |                        |                  |                                                                                                                                          |
| I <sub>DD</sub>                                             | 0.001         | 1.0                    | μA typ<br>μA max | V <sub>DD</sub> = 3.3 V<br>Digital Inputs = 0 V or 3.3 V                                                                                 |

## NOTES

<sup>1</sup>Temperature range is –40°C to +85°C.

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

Specifications subject to change without notice.

# ADG706/ADG707

## DUAL SUPPLY<sup>1</sup> ( $V_{DD} = +2.5 \text{ V} \pm 10\%$ , $V_{SS} = -2.5 \text{ V} \pm 10\%$ , $GND = 0 \text{ V}$ , unless otherwise noted.)

| Parameter                                                | 25°C       | -40°C<br>to +85°C    | Unit              | Test Conditions/Comments                                                            |
|----------------------------------------------------------|------------|----------------------|-------------------|-------------------------------------------------------------------------------------|
| <b>ANALOG SWITCH</b>                                     |            |                      |                   |                                                                                     |
| Analog Signal Range                                      |            | $V_{SS}$ to $V_{DD}$ | V                 |                                                                                     |
| ON Resistance ( $R_{ON}$ )                               | 2.5        |                      | $\Omega$ typ      | $V_S = V_{SS}$ to $V_{DD}$ , $I_{DS} = 10 \text{ mA}$ ;                             |
|                                                          | 4.5        | 5                    | $\Omega$ max      | Test Circuit 1                                                                      |
| ON Resistance Match Between Channels ( $\Delta R_{ON}$ ) |            | 0.3                  | $\Omega$ typ      | $V_S = V_{SS}$ to $V_{DD}$ , $I_{DS} = 10 \text{ mA}$                               |
| ON Resistance Flatness ( $R_{FLAT(ON)}$ )                | 0.5        | 0.8                  | $\Omega$ max      |                                                                                     |
|                                                          |            | 1.2                  | $\Omega$ typ      | $V_S = V_{SS}$ to $V_{DD}$ , $I_{DS} = 10 \text{ mA}$                               |
|                                                          |            |                      | $\Omega$ max      |                                                                                     |
| <b>LEAKAGE CURRENTS</b>                                  |            |                      |                   |                                                                                     |
| Source OFF Leakage $I_S$ (OFF)                           | $\pm 0.01$ |                      | nA typ            | $V_{DD} = +2.75 \text{ V}$ , $V_{SS} = -2.75 \text{ V}$                             |
|                                                          | $\pm 0.1$  | $\pm 0.3$            | nA max            | $V_S = +2.25 \text{ V}/-1.25 \text{ V}$ , $V_D = -1.25 \text{ V}/+2.25 \text{ V}$ ; |
| Drain OFF Leakage $I_D$ (OFF)                            | $\pm 0.01$ |                      | nA typ            | Test Circuit 2                                                                      |
| ADG706                                                   | $\pm 0.4$  | $\pm 1.5$            | nA max            | $V_S = +2.25 \text{ V}/-1.25 \text{ V}$ , $V_D = -1.25 \text{ V}/+2.25 \text{ V}$ ; |
| ADG707                                                   | $\pm 0.2$  | $\pm 1$              | nA max            | Test Circuit 3                                                                      |
| Channel ON Leakage $I_D$ , $I_S$ (ON)                    | $\pm 0.01$ |                      | nA typ            | $V_S = V_D = +2.25 \text{ V}/-1.25 \text{ V}$ , Test Circuit 4                      |
| ADG706                                                   | $\pm 0.4$  | $\pm 1.5$            | nA max            |                                                                                     |
| ADG707                                                   | $\pm 0.2$  | $\pm 1$              | nA max            |                                                                                     |
| <b>DIGITAL INPUTS</b>                                    |            |                      |                   |                                                                                     |
| Input High Voltage, $V_{INH}$                            |            | 1.7                  | V min             |                                                                                     |
| Input Low Voltage, $V_{INL}$                             |            | 0.7                  | V max             |                                                                                     |
| Input Current                                            |            |                      |                   |                                                                                     |
| $I_{INL}$ or $I_{INH}$                                   | 0.005      |                      | $\mu\text{A}$ typ | $V_{IN} = V_{INL}$ or $V_{INH}$                                                     |
|                                                          |            | $\pm 0.1$            | $\mu\text{A}$ max |                                                                                     |
| $C_{IN}$ , Digital Input Capacitance                     | 5          |                      | pF typ            |                                                                                     |
| <b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>               |            |                      |                   |                                                                                     |
| $t_{TRANSITION}$                                         | 40         |                      | ns typ            | $R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ , Test Circuit 5                         |
|                                                          |            | 60                   | ns max            | $V_{S1} = 1.5 \text{ V}/0 \text{ V}$ , $V_{S16} = 0 \text{ V}/1.5 \text{ V}$        |
| Break-Before-Make Time Delay, $t_D$                      | 15         |                      | ns typ            | $R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ ;                                        |
|                                                          |            | 1                    | ns min            | $V_S = 1.5 \text{ V}$ , Test Circuit 6                                              |
| $t_{ON}$ (EN)                                            | 32         |                      | ns typ            | $R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ ;                                        |
|                                                          |            | 50                   | ns max            | $V_S = 1.5 \text{ V}$ , Test Circuit 7                                              |
| $t_{OFF}$ (EN)                                           | 16         |                      | ns typ            | $R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ ;                                        |
|                                                          |            | 26                   | ns max            | $V_S = 1.5 \text{ V}$ , Test Circuit 7                                              |
| Charge Injection                                         | $\pm 8$    |                      | pC typ            | $V_S = 0 \text{ V}$ , $R_S = 0 \Omega$ , $C_L = 1 \text{ nF}$ ;                     |
|                                                          |            |                      |                   | Test Circuit 8                                                                      |
| OFF Isolation                                            | -60        |                      | dB typ            | $R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ , $f = 10 \text{ MHz}$ ;                   |
|                                                          | -80        |                      | dB typ            | $R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ , $f = 1 \text{ MHz}$ ;                    |
|                                                          |            |                      |                   | Test Circuit 9                                                                      |
| Channel-to-Channel Crosstalk                             | -60        |                      | dB typ            | $R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ , $f = 10 \text{ MHz}$ ;                   |
|                                                          | -80        |                      | dB typ            | $R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ , $f = 1 \text{ MHz}$ ;                    |
|                                                          |            |                      |                   | Test Circuit 10                                                                     |
| -3 dB Bandwidth                                          |            |                      |                   |                                                                                     |
| ADG706                                                   | 25         |                      | MHz typ           | $R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ , Test Circuit 9                           |
| ADG707                                                   | 36         |                      | MHz typ           | $R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ , Test Circuit 9                           |
| $C_S$ (OFF)                                              | 13         |                      | pF typ            | $f = 1 \text{ MHz}$                                                                 |
| $C_D$ (OFF)                                              |            |                      |                   |                                                                                     |
| ADG706                                                   | 180        |                      | pF typ            | $f = 1 \text{ MHz}$                                                                 |
| ADG707                                                   | 90         |                      | pF typ            | $f = 1 \text{ MHz}$                                                                 |
| $C_D$ , $C_S$ (ON)                                       |            |                      |                   |                                                                                     |
| ADG706                                                   | 200        |                      | pF typ            | $f = 1 \text{ MHz}$                                                                 |
| ADG707                                                   | 100        |                      | pF typ            | $f = 1 \text{ MHz}$                                                                 |
| <b>POWER REQUIREMENTS</b>                                |            |                      |                   |                                                                                     |
| $I_{DD}$                                                 | 0.001      |                      | $\mu\text{A}$ typ | $V_{DD} = +2.75 \text{ V}$                                                          |
|                                                          |            | 1.0                  | $\mu\text{A}$ max | Digital Inputs = 0 V or 2.75 V                                                      |
| $I_{SS}$                                                 | 0.001      |                      | $\mu\text{A}$ typ | $V_{SS} = -2.75 \text{ V}$                                                          |
|                                                          |            | 1.0                  | $\mu\text{A}$ max | Digital Inputs = 0 V or 2.75 V                                                      |

### NOTES

<sup>1</sup>Temperature range is -40°C to +85°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> | 7 V                                                                                    |
| V <sub>DD</sub> to GND             | −0.3 V to +7 V                                                                         |
| V <sub>SS</sub> to GND             | +0.3 V to −3.5 V                                                                       |
| Analog Inputs <sup>2</sup>         | V <sub>SS</sub> − 0.3 V to V <sub>DD</sub> + 0.3 V or<br>30 mA, Whichever Occurs First |
| Digital Inputs <sup>2</sup>        | −0.3 V to V <sub>DD</sub> + 0.3 V or<br>30 mA, Whichever Occurs First                  |
| Peak Current, S or D               | 100 mA<br>(Pulsed at 1 ms, 10% Duty Cycle max)                                         |
| Continuous Current, S or D         | 30 mA                                                                                  |
| Operating Temperature Range        |                                                                                        |
| Industrial                         | −40°C to +85°C                                                                         |

|                                      |                 |
|--------------------------------------|-----------------|
| Storage Temperature Range            | −65°C to +150°C |
| Junction Temperature                 | 150°C           |
| TSSOP Package                        |                 |
| θ <sub>JA</sub> Thermal Impedance    | 97.9°C/W        |
| θ <sub>JC</sub> Thermal Impedance    | 14°C/W          |
| Lead Temperature, Soldering (10 sec) | 300°C           |
| IR Reflow, Peak Temperature          | 220°C           |

## 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; 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.

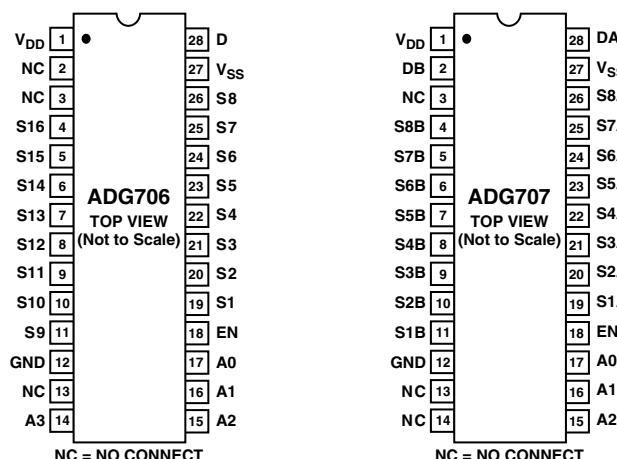
<sup>2</sup>Overvoltages at A, EN, S, or D will be clamped by internal diodes. Current should be limited to the maximum ratings given.

## ORDERING GUIDE

| Model <sup>1</sup> | Temperature Range | Package Description                               | Package Option |
|--------------------|-------------------|---------------------------------------------------|----------------|
| ADG706BRU          | −40°C to +85°C    | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28          |
| ADG706BRU-REEL7    | −40°C to +85°C    | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28          |
| ADG706BRUZ         | −40°C to +85°C    | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28          |
| ADG706BRUZ-REEL    | −40°C to +85°C    | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28          |
| ADG706BRUZ-REEL7   | −40°C to +85°C    | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28          |
| ADG707BRU          | −40°C to +85°C    | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28          |
| ADG707BRU-REEL     | −40°C to +85°C    | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28          |
| ADG707BRUZ         | −40°C to +85°C    | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28          |
| ADG707BRUZ-REEL7   | −40°C to +85°C    | 28-Lead Thin Shrink Small Outline Package [TSSOP] | RU-28          |

<sup>1</sup> Z = RoHS Compliant Part.

## PIN CONFIGURATIONS



## CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the ADG706/ADG707 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



# ADG706/ADG707

**Table I. ADG706 Truth Table**

| A3 | A2 | A1 | A0 | EN | ON Switch |
|----|----|----|----|----|-----------|
| X  | X  | X  | X  | 0  | NONE      |
| 0  | 0  | 0  | 0  | 1  | 1         |
| 0  | 0  | 0  | 1  | 1  | 2         |
| 0  | 0  | 1  | 0  | 1  | 3         |
| 0  | 0  | 1  | 1  | 1  | 4         |
| 0  | 1  | 0  | 0  | 1  | 5         |
| 0  | 1  | 0  | 1  | 1  | 6         |
| 0  | 1  | 1  | 0  | 1  | 7         |
| 0  | 1  | 1  | 1  | 1  | 8         |
| 1  | 0  | 0  | 0  | 1  | 9         |
| 1  | 0  | 0  | 1  | 1  | 10        |
| 1  | 0  | 1  | 0  | 1  | 11        |
| 1  | 0  | 1  | 1  | 1  | 12        |
| 1  | 1  | 0  | 0  | 1  | 13        |
| 1  | 1  | 0  | 1  | 1  | 14        |
| 1  | 1  | 1  | 0  | 1  | 15        |
| 1  | 1  | 1  | 1  | 1  | 16        |

X = Don't Care

**Table II. ADG707 Truth Table**

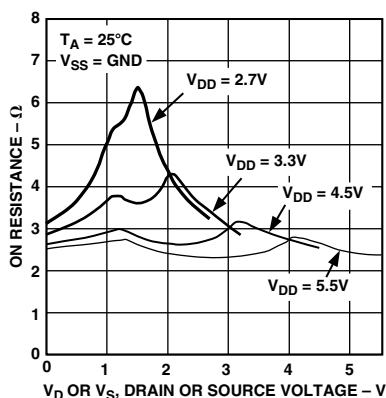
| A2 | A1 | A0 | EN | ON Switch Pair |
|----|----|----|----|----------------|
| X  | X  | X  | 0  | NONE           |
| 0  | 0  | 0  | 1  | 1              |
| 0  | 0  | 1  | 1  | 2              |
| 0  | 1  | 0  | 1  | 3              |
| 0  | 1  | 1  | 1  | 4              |
| 1  | 0  | 0  | 1  | 5    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

X = Don't Care

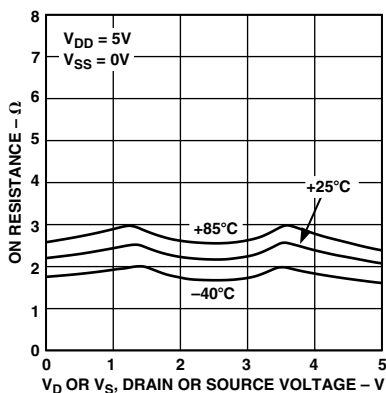
## TERMINOLOGY

|                    |                                                                                                                                                  |                  |                                                                                                                                                         |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| $V_{DD}$           | Most positive power supply potential                                                                                                             | $C_D$ (OFF)      | “OFF” Switch drain capacitance. Measured with reference to ground.                                                                                      |
| $V_{SS}$           | Most negative power supply in a dual-supply application. In single-supply applications, this should be tied to ground at the device.             | $C_D, C_S$ (ON)  | “ON” Switch capacitance. Measured with reference to ground.                                                                                             |
| $I_{DD}$           | Positive supply current                                                                                                                          | $C_{IN}$         | Digital input capacitance                                                                                                                               |
| $I_{SS}$           | Negative supply current                                                                                                                          | $t_{TRANSITION}$ | Delay time measured between the 50% and 90% points of the digital inputs and the switch “ON” condition when switching from one address state to another |
| GND                | Ground (0 V) reference                                                                                                                           | $t_{ON}$ (EN)    | Delay time between the 50% and 90% points of the EN digital input and the Switch “ON” condition                                                         |
| S                  | Source terminal. May be an input or output.                                                                                                      | $t_{OFF}$ (EN)   | Delay time between the 50% and 90% points of the EN digital input and the Switch “OFF” condition                                                        |
| D                  | Drain terminal. May be an input or output.                                                                                                       | $t_{OPEN}$       | “OFF” Time measured between the 80% points of both switches when switching from one address state to another                                            |
| AX                 | Logic control input                                                                                                                              | Charge Injection | Measure of the glitch impulse transferred from the digital input to the analog output during switching                                                  |
| EN                 | Active high device enable                                                                                                                        | OFF Isolation    | Measure of unwanted signal coupling through an “OFF” switch                                                                                             |
| $V_D$ ( $V_S$ )    | Analog voltage on terminals D, S                                                                                                                 | Crosstalk        | Measure of unwanted signal that is coupled through from one channel to another as a result of parasitic capacitance                                     |
| $R_{ON}$           | Ohmic resistance between D and S                                                                                                                 | Bandwidth        | Frequency at which the output is attenuated by 3 dB                                                                                                     |
| $\Delta R_{ON}$    | ON Resistance match between any two channels, i.e., $R_{ONmax} - R_{ONmin}$                                                                      | ON Response      | Frequency response of the “ON” Switch                                                                                                                   |
| $R_{FLAT(ON)}$     | Flatness is defined as the difference between the maximum and minimum value of ON resistance as measured over the specified analog signal range. | Insertion Loss   | Loss due to the ON Resistance of the switch                                                                                                             |
| $I_S$ (OFF)        | Source leakage current with the Switch “OFF”                                                                                                     |                  |                                                                                                                                                         |
| $I_D$ (OFF)        | Drain leakage current with the Switch “OFF”                                                                                                      |                  |                                                                                                                                                         |
| $I_D, I_S$ (ON)    | Channel leakage current with the Switch “ON”                                                                                                     |                  |                                                                                                                                                         |
| $V_{INL}$          | Maximum input voltage for Logic “0”                                                                                                              |                  |                                                                                                                                                         |
| $V_{INH}$          | Minimum input voltage for Logic “1”                                                                                                              |                  |                                                                                                                                                         |
| $I_{INL}(I_{INH})$ | Input current of the digital input                                                                                                               |                  |                                                                                                                                                         |
| $C_S$ (OFF)        | “OFF” Switch Source Capacitance. Measured with reference to ground.                                                                              |                  |                                                                                                                                                         |

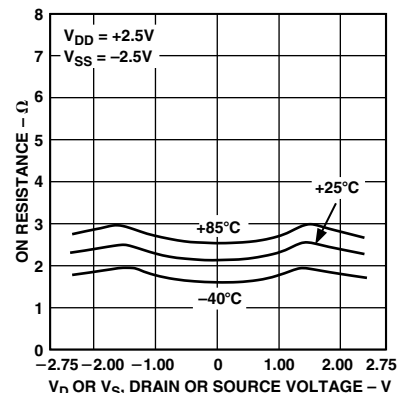
# Typical Performance Characteristics—ADG706/ADG707



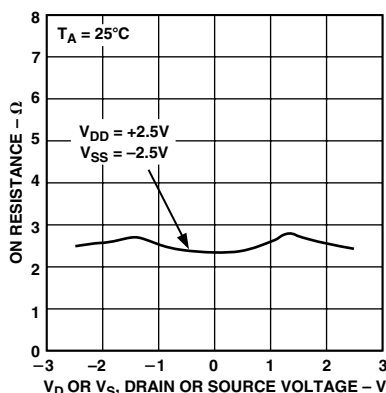
TPC 1. ON Resistance as a Function of  $V_D$  ( $V_S$ ) for Single Supply



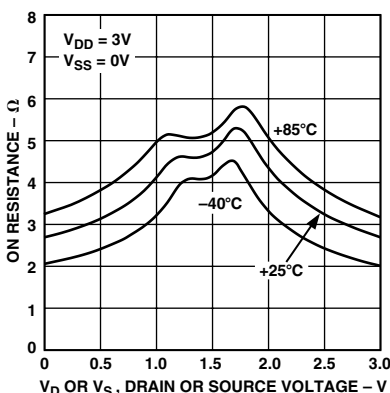
TPC 2. ON Resistance as a Function of  $V_D$  ( $V_S$ ) for Different Temperatures, Single Supply



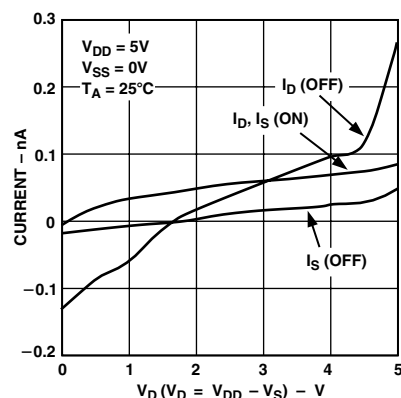
TPC 3. ON Resistance as a Function of  $V_D$  ( $V_S$ ) for Different Temperatures, Dual Supply



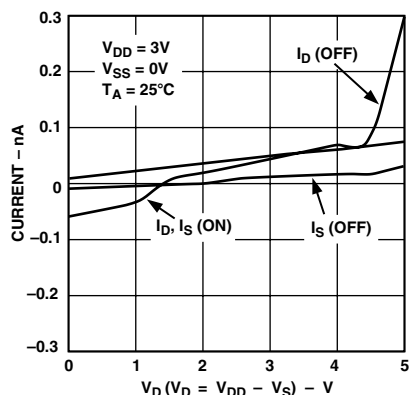
TPC 4. ON Resistance as a Function of  $V_D$  ( $V_S$ ) for Dual Supply



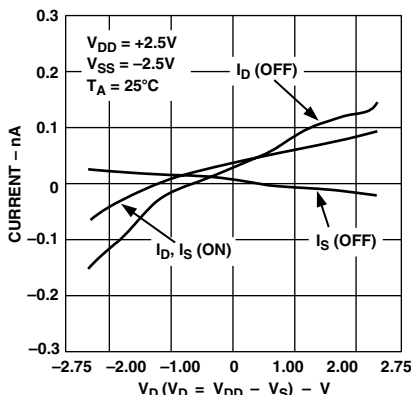
TPC 5. ON Resistance as a Function of  $V_D$  ( $V_S$ ) for Different Temperatures, Single Supply



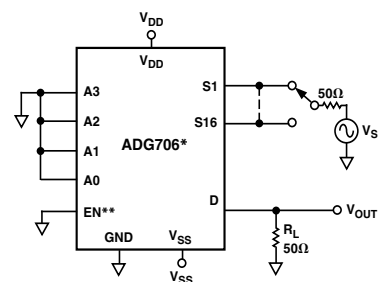
TPC 6. Leakage Currents as a Function of  $V_D$  ( $V_S$ )



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



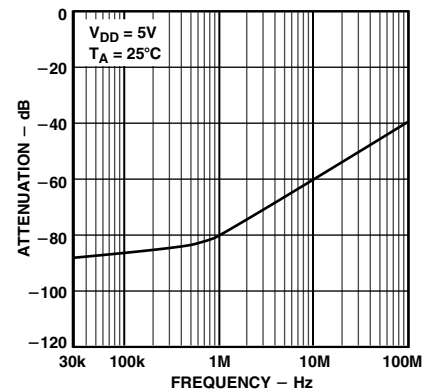
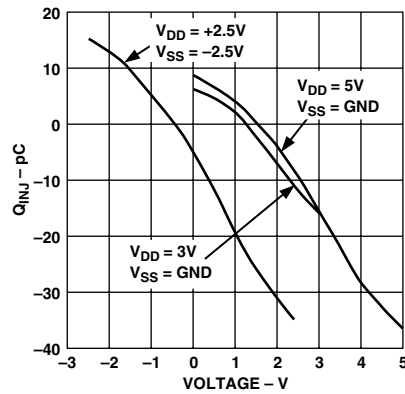
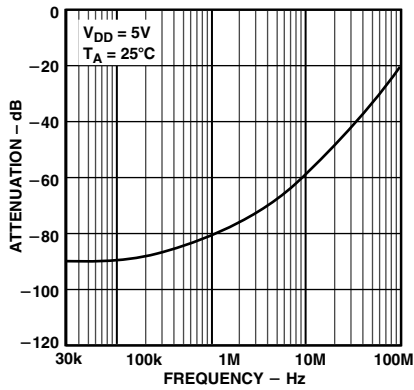
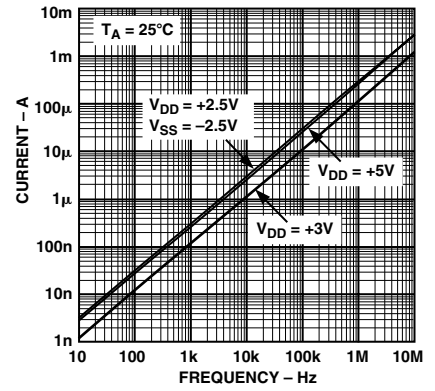
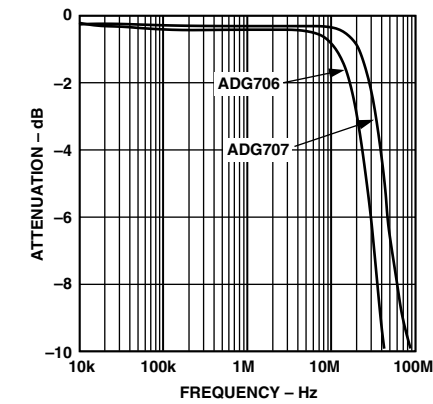
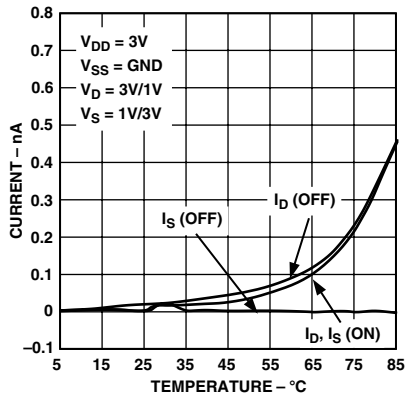
TPC 8. Leakage Currents as a Function of  $V_D$  ( $V_S$ )



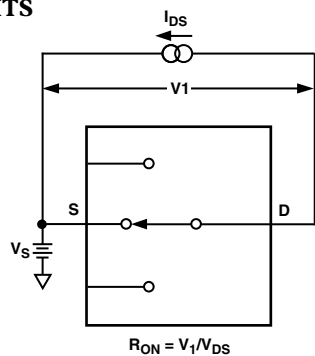
\*SIMILAR CONNECTION FOR ADG707  
 \*\*CONNECT TO 2.4V FOR BANDWIDTH MEASUREMENTS  
 OFF ISOLATION =  $20\log_{10}(V_{OUT}/V_S)$   
 INSERTION LOSS =  $20\log_{10}\left(\frac{V_{OUT} \text{ WITH SWITCH}}{V_{OUT} \text{ WITHOUT SWITCH}}\right)$

TPC 9. Leakage Currents as a Function of Temperature

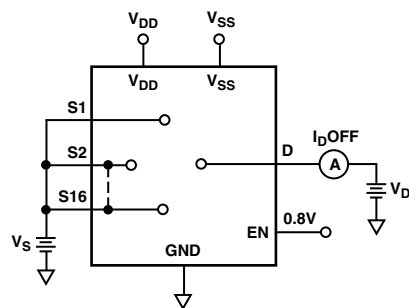
# ADG706/ADG707



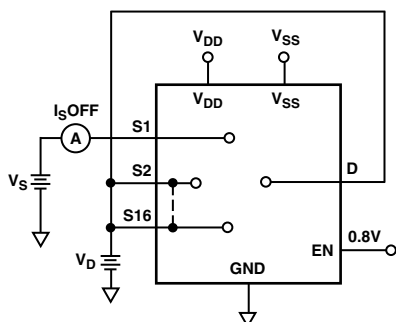
## TEST CIRCUITS



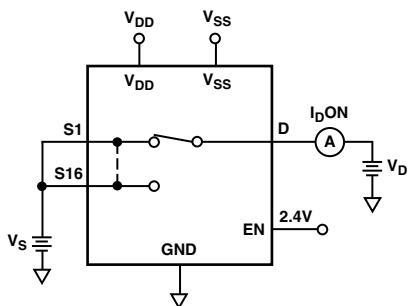
Test Circuit 1. ON Resistance



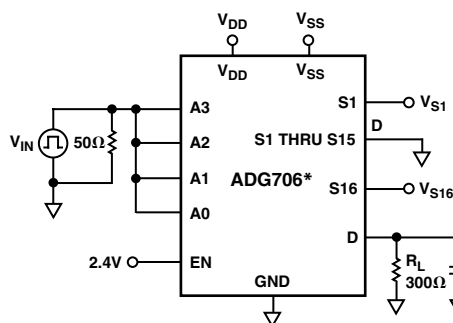
Test Circuit 3.  $I_D$  (OFF)



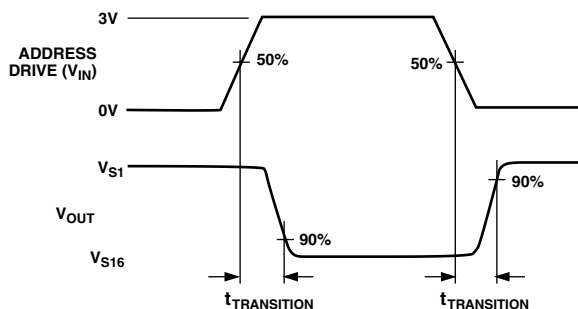
Test Circuit 2.  $I_S$  (OFF)



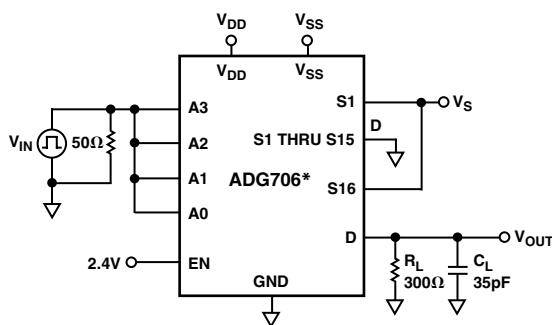
Test Circuit 4.  $I_D$  (ON)



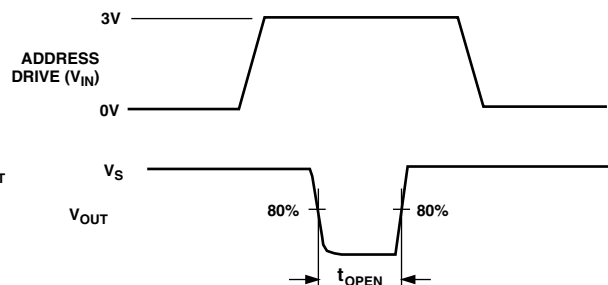
\*SIMILAR CONNECTION FOR ADG707



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

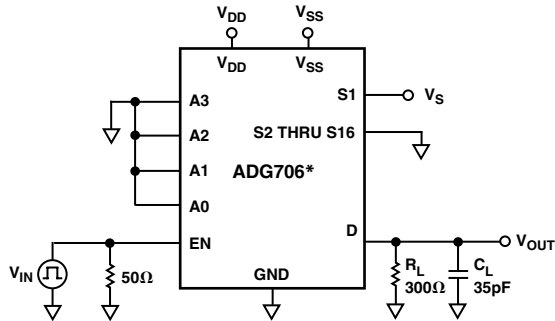


\*SIMILAR CONNECTION FOR ADG707



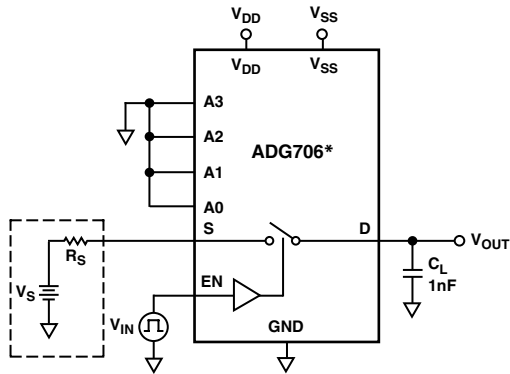
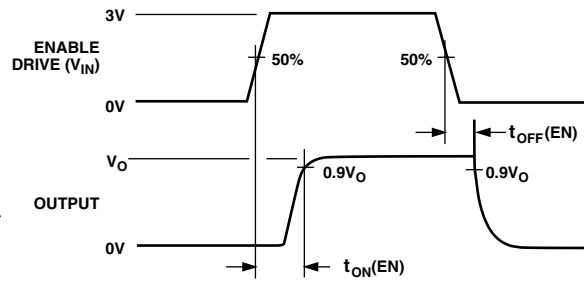
Test Circuit 6. Break-Before-Make Delay,  $t_{OPEN}$

# ADG706/ADG707



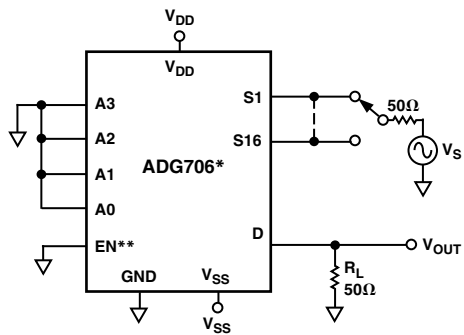
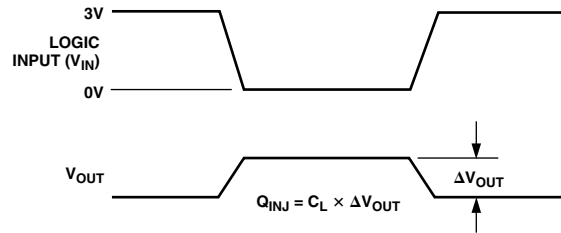
\*SIMILAR CONNECTION FOR ADG707

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



\*SIMILAR CONNECTION FOR ADG707

Test Circuit 8. Charge Injection



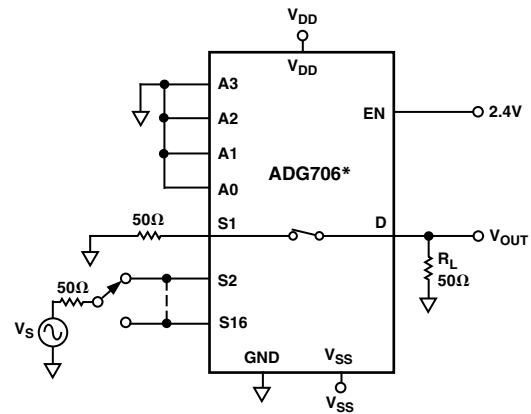
\*SIMILAR CONNECTION FOR ADG707

\*\*CONNECT TO 2.4V FOR BANDWIDTH MEASUREMENTS

OFF ISOLATION =  $20\text{LOG}_{10}(V_{OUT}/V_S)$

INSERTION LOSS =  $20\text{LOG}_{10}\left(\frac{V_{OUT} \text{ WITH SWITCH}}{V_{OUT} \text{ WITHOUT SWITCH}}\right)$

Test Circuit 9. OFF Isolation and Bandwidth

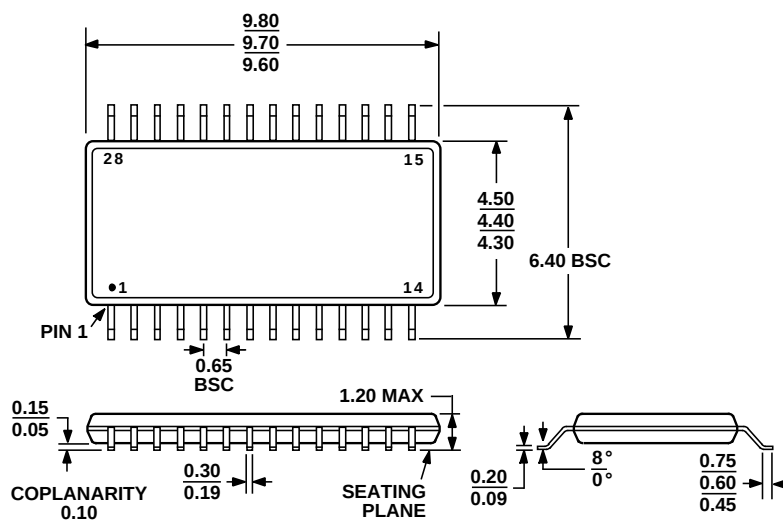


\*SIMILAR CONNECTION FOR ADG707

CHANNEL-TO-CHANNEL CROSSTALK =  $20\text{LOG}_{10}(V_{OUT}/V_S)$

Test Circuit 10. Channel-to-Channel Crosstalk

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AE

28-Lead Thin Shrink Small Outline Package [TSSOP]  
(RU-28)

Dimensions shown in millimeters

# ADG706/ADG707

## Revision History

| Location                                              | Page |
|-------------------------------------------------------|------|
| <b>3/16—Data Sheet changed from REV. A to REV. B.</b> |      |
| Changes to ORDERING GUIDE . . . . .                   | 5    |
| Updated OUTLINE DIMENSIONS . . . . .                  | 11   |
| <b>5/02—Data Sheet changed from REV. 0 to REV. A.</b> |      |
| Edits to FEATURES and PRODUCT HIGHLIGHTS . . . . .    | 1    |
| Changes to SPECIFICATIONS . . . . .                   | 2    |
| Edits to ABSOLUTE MAXIMUM RATINGS notes . . . . .     | 5    |
| Edits to TPCs 2, 3, 4, 6–9, 12, 14 . . . . .          | 7–8  |
| Edits to Test Circuits 9 and 10 . . . . .             | 10   |