

## FEATURES

**Latch-up immune under all circumstances**  
**2.5 pF off source capacitance**  
**12 pF off drain capacitance**  
**-0.6 pC charge injection**  
**Low leakage: 0.4 nA maximum at 85°C**  
**±9 V to ±22 V dual-supply operation**  
**9 V to 40 V single-supply operation**  
**48 V supply maximum ratings**  
**Fully specified at ±15 V, ±20 V, +12 V, and +36 V**  
**V<sub>SS</sub> to V<sub>DD</sub> analog signal range**

## APPLICATIONS

**High voltage signal routing**  
**Automatic test equipment**  
**Analog front-end circuits**  
**Precision data acquisition**  
**Industrial instrumentation**  
**Amplifier gain select**  
**Relay replacement**

## GENERAL DESCRIPTION

The **ADG5236** is a monolithic CMOS device containing two independently selectable single-pole/double throw (SPDT) switches. An EN input on the LFCSP package enables or disables the device. When disabled, all channels switch off. Each switch conducts equally well in both directions when on and has an input signal range that extends to the supplies. In the off condition, signal levels up to the supplies are blocked. Both switches exhibit break-before-make switching action for use in multiplexer applications.

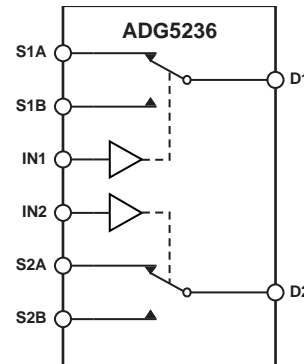
The ultralow capacitance and charge injection of these switches make them ideal solutions for data acquisition and sample-and-hold applications, where low glitch and fast settling are required. Fast switching speed together with high signal bandwidth make the device suitable for video signal switching.

Rev. B

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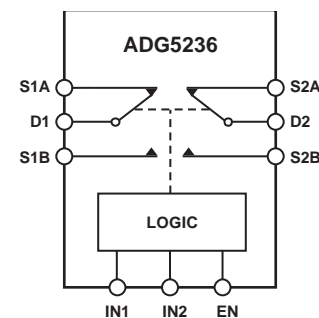
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## FUNCTIONAL BLOCK DIAGRAMS



SWITCHES SHOWN FOR A LOGIC 1 INPUT. 09769-001

Figure 1. TSSOP Package



SWITCHES SHOWN FOR A LOGIC 1 INPUT. 09769-002

Figure 2. LFCSP Package

## PRODUCT HIGHLIGHTS

- Trench Isolation Guards Against Latch-Up.**  
 A dielectric trench separates the P and N channel transistors thereby preventing latch-up even under severe overvoltage conditions.
- Ultralow Capacitance and <1 pC Charge Injection.**
- Dual-Supply Operation.**  
 For applications where the analog signal is bipolar, the **ADG5236** can be operated from dual supplies up to ±22 V.
- Single-Supply Operation.**  
 For applications where the analog signal is unipolar, the **ADG5236** can be operated from a single rail power supply up to 40 V.
- 3 V Logic-Compatible Digital Inputs.**  
 $V_{INH} = 2.0 \text{ V}$ ,  $V_{INL} = 0.8 \text{ V}$ .
- No V<sub>L</sub> Logic Power Supply Required.**

# ADG5236\* Product Page Quick Links

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### **Data Sheet**

- ADG5236: High Voltage Latch-Up Proof, Dual SPDT Switches Data Sheet

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- CN0269

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- Switches and Multiplexers Product Selection Guide

## [Design Resources](#)

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**TABLE OF CONTENTS**

|   |   |  |    |
|---|---|--|----|
| Features .....                                | 1 | Absolute Maximum Ratings .....                     | 8  |
| Applications.....                             | 1 | ESD Caution.....                                   | 8  |
| Functional Block Diagrams.....                | 1 | Pin Configurations and Function Descriptions ..... | 9  |
| General Description .....                     | 1 | Truth Tables for Switches .....                    | 9  |
| Product Highlights .....                      | 1 | Typical Performance Characteristics .....          | 10 |
| Revision History .....                        | 2 | Test Circuits.....                                 | 14 |
| Specifications.....                           | 3 | Terminology .....                                  | 16 |
| ±15 V Dual Supply .....                       | 3 | Trench Isolation .....                             | 17 |
| ±20 V Dual Supply .....                       | 4 | Applications Information .....                     | 18 |
| 12 V Single Supply.....                       | 5 | Outline Dimensions .....                           | 19 |
| 36 V Single Supply.....                       | 6 | Ordering Guide .....                               | 19 |
| Continuous Current per Channel, Sx or Dx..... | 7 |  |    |

**REVISION HISTORY**

**11/13—Rev. A to Rev. B**

|   |    |
|---|----|
| Changes to Features and Applications Sections ..... | 1  |
| Changes to Figure 23.....                           | 13 |

**4/12—Rev. 0 to Rev. A**

|                                  |    |
|----------------------------------|----|
| Updated Outline Dimensions ..... | 19 |
| Changes to Ordering Guide .....  | 19 |

**7/11—Revision 0: Initial Version**

## SPECIFICATIONS

## ±15 V DUAL SUPPLY

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

Table 1.

| Parameter  | 25°C          | -40°C to +85°C | -40°C to +125°C      | Unit   | Test Conditions/Comments  |
|--|---------------|----------------|----------------------|--|---|
| <b>ANALOG SWITCH</b>                                     |               |                |                      |  |   |
| Analog Signal Range                                      |               |                | $V_{DD}$ to $V_{SS}$ | V max  |   |
| On Resistance, $R_{ON}$                                  | 160<br>200    | 250            | 280                  | $\Omega$ typ<br>$\Omega$ max                 | $V_S = \pm 10\text{ V}$ , $I_S = -1\text{ mA}$ , see Figure 25<br>$V_{DD} = +13.5\text{ V}$ , $V_{SS} = -13.5\text{ V}$<br>$V_S = \pm 10\text{ V}$ , $I_S = -1\text{ mA}$ |
| On-Resistance Match<br>Between Channels, $\Delta R_{ON}$ | 1.4           |                |                      | $\Omega$ typ                                 |   |
| On-Resistance Flatness, $R_{FLAT(ON)}$                   | 8<br>38<br>50 | 9<br>65        | 10<br>70             | $\Omega$ max<br>$\Omega$ typ<br>$\Omega$ max | $V_S = \pm 10\text{ V}$ , $I_S = -1\text{ mA}$  |
| <b>LEAKAGE CURRENTS</b>                                  |               |                |                      |  |   |
| Source Off Leakage, $I_S$ (Off)                          | 0.01<br>0.1   | 0.2            | 0.4                  | nA typ<br>nA max                             | $V_{DD} = +16.5\text{ V}$ , $V_{SS} = -16.5\text{ V}$<br>$V_S = \pm 10\text{ V}$ , $V_D = \mp 10\text{ V}$ , see Figure 27  |
| Drain Off Leakage, $I_D$ (Off)                           | 0.01<br>0.1   | 0.4            | 1.2                  | nA typ<br>nA max                             | $V_S = \pm 10\text{ V}$ , $V_D = \mp 10\text{ V}$ , see Figure 27   |
| Channel On Leakage, $I_D$ (On), $I_S$ (On)               | 0.02<br>0.2   | 0.4            | 1.2                  | nA typ<br>nA max                             | $V_S = V_D = \pm 10\text{ V}$ , see Figure 24   |
| <b>DIGITAL INPUTS</b>                                    |               |                |                      |  |   |
| Input High Voltage, $V_{INH}$                            |               |                | 2.0                  | V min  |   |
| Input Low Voltage, $V_{INL}$                             |               |                | 0.8                  | V max  |   |
| Input Current, $I_{INL}$ or $I_{INH}$                    | 0.002         |                | $\pm 0.1$            | $\mu\text{A}$ typ<br>$\mu\text{A}$ max       | $V_{IN} = V_{GND}$ or $V_{DD}$  |
| Digital Input Capacitance, $C_{IN}$                      | 3             |                |                      | pF typ                                       |   |
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>               |               |                |                      |  |   |
| Transition Time, $t_{TRANSITION}$                        | 150<br>230    | 280            | 315                  | ns typ<br>ns max                             | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$<br>$V_S = 10\text{ V}$ , see Figure 30   |
| $t_{ON}$   | 170<br>215    | 265            | 300                  | ns typ<br>ns max                             | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$<br>$V_S = 10\text{ V}$ , see Figure 32   |
| $t_{OFF}$  | 160<br>185    | 205            | 225                  | ns typ<br>ns max                             | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$<br>$V_S = 10\text{ V}$ , see Figure 32   |
| Break-Before-Make Time Delay, $t_D$                      | 75            |                | 30                   | ns typ<br>ns min                             | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$<br>$V_{S1} = V_{S2} = 10\text{ V}$ , see Figure 31   |
| Charge Injection, $Q_{INJ}$                              | -0.6          |                |                      | pC typ                                       | $V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ,<br>see Figure 33   |
| Off Isolation  | -85           |                |                      | dB typ                                       | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ,<br>see Figure 28  |
| Channel-to-Channel Crosstalk                             | -85           |                |                      | dB typ                                       | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ,<br>see Figure 26  |
| -3 dB Bandwidth  | 266           |                |                      | MHz typ                                      | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , see Figure 29  |
| Insertion Loss   | -7            |                |                      | dB typ                                       | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ,<br>see Figure 29  |
| $C_S$ (Off)  | 2.5           |                |                      | pF typ                                       | $V_S = 0\text{ V}$ , $f = 1\text{ MHz}$   |
| $C_D$ (Off)  | 12            |                |                      | pF typ                                       | $V_S = 0\text{ V}$ , $f = 1\text{ MHz}$   |
| $C_D$ (On), $C_S$ (On)                                   | 15            |                |                      | pF typ                                       | $V_S = 0\text{ V}$ , $f = 1\text{ MHz}$   |

| Parameter          | 25°C  | -40°C to +85°C | -40°C to +125°C | Unit              | Test Conditions/Comments  |
|--------------------|-------|----------------|-----------------|-------------------|---|
| POWER REQUIREMENTS |       |                |                 |                   |   |
| $I_{DD}$           | 45    |                |                 | $\mu\text{A typ}$ | $V_{DD} = +16.5\text{ V}$ , $V_{SS} = -16.5\text{ V}$<br>Digital inputs = 0 V or $V_{DD}$ |
|                    | 55    |                | 70              | $\mu\text{A max}$ |   |
| $I_{SS}$           | 0.001 |                |                 | $\mu\text{A typ}$ | Digital inputs = 0 V or $V_{DD}$  |
|                    |       |                | 1               | $\mu\text{A max}$ |   |
| $V_{DD}/V_{SS}$    |       |                | $\pm 9/\pm 22$  | V min/V max       | GND = 0 V   |

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

## $\pm 20\text{ V DUAL SUPPLY}$

$V_{DD} = +20\text{ V} \pm 10\%$ ,  $V_{SS} = -20\text{ V} \pm 10\%$ , GND = 0 V, unless otherwise noted.

Table 2.

| Parameter  | 25°C  | -40°C to +85°C | -40°C to +125°C      | Unit              | Test Conditions/Comments   |
|--|-------|----------------|----------------------|-------------------|--|
| ANALOG SWITCH  |       |                |                      |                   |  |
| Analog Signal Range                                      |       |                | $V_{DD}$ to $V_{SS}$ | V max             |  |
| On Resistance, $R_{ON}$                                  | 140   |                |                      | $\Omega$ typ      | $V_S = \pm 15\text{ V}$ , $I_S = -1\text{ mA}$ , see Figure 25   |
|  | 160   | 200            | 230                  | $\Omega$ max      | $V_{DD} = +18\text{ V}$ , $V_{SS} = -18\text{ V}$  |
| On-Resistance Match<br>Between Channels, $\Delta R_{ON}$ | 1.3   |                |                      | $\Omega$ typ      | $V_S = \pm 15\text{ V}$ , $I_S = -1\text{ mA}$   |
|  | 8     | 9              | 10                   | $\Omega$ max      |  |
| On-Resistance Flatness, $R_{FLAT(ON)}$                   | 33    |                |                      | $\Omega$ typ      | $V_S = \pm 15\text{ V}$ , $I_S = -1\text{ mA}$   |
|  | 45    | 55             | 60                   | $\Omega$ max      |  |
| LEAKAGE CURRENTS   |       |                |                      |                   |  |
| Source Off Leakage, $I_S$ (Off)                          | 0.01  |                |                      | nA typ            | $V_{DD} = +22\text{ V}$ , $V_{SS} = -22\text{ V}$<br>$V_S = \pm 15\text{ V}$ , $V_D = \mp 15\text{ V}$ , see Figure 27 |
|  | 0.1   | 0.2            | 0.4                  | nA max            |  |
| Drain Off Leakage, $I_D$ (Off)                           | 0.01  |                |                      | nA typ            | $V_S = \pm 15\text{ V}$ , $V_D = \mp 15\text{ V}$ , see Figure 27  |
|  | 0.1   | 0.4            | 1.2                  | nA max            |  |
| Channel On Leakage, $I_D$ (On), $I_S$ (On)               | 0.02  |                |                      | nA typ            | $V_S = V_D = \pm 15\text{ V}$ , see Figure 24  |
|  | 0.2   | 0.4            | 1.2                  | nA max            |  |
| DIGITAL INPUTS   |       |                |                      |                   |  |
| Input High Voltage, $V_{INH}$                            |       |                | 2.0                  | V min             |  |
| Input Low Voltage, $V_{INL}$                             |       |                | 0.8                  | V max             |  |
| Input Current, $I_{INL}$ or $I_{INH}$                    | 0.002 |                |                      | $\mu\text{A typ}$ | $V_{IN} = V_{GND}$ or $V_{DD}$   |
|  |       |                | $\pm 0.1$            | $\mu\text{A max}$ |  |
| Digital Input Capacitance, $C_{IN}$                      | 3     |                |                      | pF typ            |  |
| DYNAMIC CHARACTERISTICS <sup>1</sup>                     |       |                |                      |                   |  |
| Transition Time, $t_{TRANSITION}$                        | 150   |                |                      | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$   |
|  | 210   | 260            | 290                  | ns max            | $V_S = 10\text{ V}$ , see Figure 30  |
| $t_{ON}$   | 150   |                |                      | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$   |
|  | 190   | 235            | 267                  | ns max            | $V_S = 10\text{ V}$ , see Figure 32  |
| $t_{OFF}$  | 155   |                |                      | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$   |
|  | 180   | 200            | 215                  | ns max            | $V_S = 10\text{ V}$ , see Figure 32  |
| Break-Before-Make Time Delay, $t_D$                      | 60    |                |                      | ns typ            | $R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$   |
|  |       |                | 30                   | ns min            | $V_{S1} = V_{S2} = 10\text{ V}$ , see Figure 31  |
| Charge Injection, $Q_{INJ}$                              | -0.6  |                |                      | pC typ            | $V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ , see Figure 33   |
| Off Isolation  | -85   |                |                      | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , see Figure 28  |
| Channel-to-Channel Crosstalk                             | -85   |                |                      | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , see Figure 26  |
| -3 dB Bandwidth  | 266   |                |                      | MHz typ           | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , see Figure 29   |
| Insertion Loss   | -7    |                |                      | dB typ            | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , see Figure 29  |

| Parameter                                | 25°C     | -40°C to +85°C | -40°C to +125°C | Unit             | Test Conditions/Comments  |
|--|----------|----------------|-----------------|------------------|---|
| C <sub>S</sub> (Off)                     | 2.5      |                |                 | pF typ           | V <sub>S</sub> = 0 V, f = 1 MHz   |
| C <sub>D</sub> (Off)                     | 12       |                |                 | pF typ           | V <sub>S</sub> = 0 V, f = 1 MHz   |
| C <sub>D</sub> (On), C <sub>S</sub> (On) | 15       |                |                 | pF typ           | V <sub>S</sub> = 0 V, f = 1 MHz   |
| <b>POWER REQUIREMENTS</b>                |          |                |                 |                  |   |
| I <sub>DD</sub>                          | 50<br>70 |                | 110             | μA typ<br>μA max | V <sub>DD</sub> = +22 V, V <sub>SS</sub> = -22 V<br>Digital inputs = 0 V or V <sub>DD</sub> |
| I <sub>SS</sub>                          | 0.001    |                | 1               | μA typ<br>μA max | Digital inputs = 0 V or V <sub>DD</sub>   |
| V <sub>DD</sub> /V <sub>SS</sub>         |          |                | ±9/±22          | V min/V max      | GND = 0 V   |

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

## 12 V SINGLE SUPPLY

V<sub>DD</sub> = 12 V ± 10%, V<sub>SS</sub> = 0 V, GND = 0 V, unless otherwise noted.

**Table 3.**

| Parameter  | 25°C               | -40°C to +85°C | -40°C to +125°C        | Unit                       | Test Conditions/Comments   |
|--|--------------------|----------------|------------------------|----------------------------|--|
| <b>ANALOG SWITCH</b>   |                    |                |                        |                            |  |
| Analog Signal Range  |                    |                | 0 V to V <sub>DD</sub> | V max                      |  |
| On Resistance, R <sub>ON</sub>                               | 350                |                |                        | Ω typ                      | V <sub>S</sub> = 0 V to 10 V, I <sub>S</sub> = -1 mA, see Figure 25  |
| On-Resistance Match Between Channels, ΔR <sub>ON</sub>       | 500<br>3           | 610            | 700                    | Ω max<br>Ω typ             | V <sub>DD</sub> = 10.8 V, V <sub>SS</sub> = 0 V<br>V <sub>S</sub> = 0 V to 10 V, I <sub>S</sub> = -1 mA                |
| On-Resistance Flatness, R <sub>FLAT (ON)</sub>               | 20<br>145<br>280   | 21<br>335      | 22<br>370              | Ω max<br>Ω typ<br>Ω max    | V <sub>S</sub> = 0 V to 10 V, I <sub>S</sub> = -1 mA   |
| <b>LEAKAGE CURRENTS</b>                                      |                    |                |                        |                            |  |
| Source Off Leakage, I <sub>S</sub> (Off)                     | 0.01               |                |                        | nA typ                     | V <sub>DD</sub> = 13.2 V, V <sub>SS</sub> = 0 V<br>V <sub>S</sub> = 1 V/10 V, V <sub>D</sub> = 10 V/1 V, see Figure 27 |
| Drain Off Leakage, I <sub>D</sub> (Off)                      | 0.1<br>0.01        | 0.2            | 0.4                    | nA max<br>nA typ           | V <sub>S</sub> = 1 V/10 V, V <sub>D</sub> = 10 V/1 V, see Figure 27  |
| Channel On Leakage, I <sub>D</sub> (On), I <sub>S</sub> (On) | 0.1<br>0.02<br>0.2 | 0.4<br>0.4     | 1.2<br>1.2             | nA max<br>nA typ<br>nA max | V <sub>S</sub> = V <sub>D</sub> = 1 V/10 V, see Figure 24  |
| <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>          | 0.002              |                | ±0.1                   | μA typ<br>μA max           | V <sub>IN</sub> = V <sub>GND</sub> or V <sub>DD</sub>  |
| Digital Input Capacitance, C <sub>IN</sub>                   | 3                  |                |                        | pF typ                     |  |
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>                   |                    |                |                        |                            |  |
| Transition Time, t <sub>TRANSITION</sub>                     | 220<br>390         | 430            | 490                    | ns typ<br>ns max           | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>V <sub>S</sub> = 8 V, see Figure 30                                  |
| t <sub>ON</sub>  | 275<br>380         | 440            | 510                    | ns typ<br>ns max           | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>V <sub>S</sub> = 8 V, see Figure 32                                  |
| t <sub>OFF</sub>   | 160<br>195         | 225            | 245                    | ns typ<br>ns max           | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>V <sub>S</sub> = 8 V, see Figure 32                                  |
| Break-Before-Make Time Delay, t <sub>D</sub>                 | 145                |                | 65                     | ns typ<br>ns min           | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>V <sub>S1</sub> = V <sub>S2</sub> = 8 V, see Figure 31               |
| Charge Injection, Q <sub>INJ</sub>                           | -0.6               |                |                        | pC typ                     | V <sub>S</sub> = 6 V, R <sub>S</sub> = 0 Ω, C <sub>L</sub> = 1 nF, see Figure 33                                       |

| Parameter                    | 25°C | –40°C to +85°C | –40°C to +125°C | Unit                                   | Test Conditions/Comments  |
|------------------------------|------|----------------|-----------------|--|---|
| Off Isolation                | –90  |                |                 | dB typ                                 | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 28 |
| Channel-to-Channel Crosstalk | –90  |                |                 | dB typ                                 | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 26 |
| –3 dB Bandwidth              | 185  |                |                 | MHz typ                                | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , see Figure 29                       |
| Insertion Loss               | –11  |                |                 | dB typ                                 | $R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ , see Figure 29 |
| $C_S$ (Off)                  | 3    |                |                 | pF typ                                 | $V_S = 6\ \text{V}$ , $f = 1\ \text{MHz}$                                       |
| $C_D$ (Off)                  | 16   |                |                 | pF typ                                 | $V_S = 6\ \text{V}$ , $f = 1\ \text{MHz}$                                       |
| $C_D$ (On), $C_S$ (On)       | 16   |                |                 | pF typ                                 | $V_S = 6\ \text{V}$ , $f = 1\ \text{MHz}$                                       |
| <b>POWER REQUIREMENTS</b>    |      |                |                 |  |   |
| $I_{DD}$                     | 40   |                | 65              | $\mu\text{A}$ typ<br>$\mu\text{A}$ max | $V_{DD} = 13.2\ \text{V}$<br>Digital inputs = 0 V or $V_{DD}$                   |
| $V_{DD}$                     |      |                | 9/40            | V min/V max                            | GND = 0 V, $V_{SS} = 0\ \text{V}$   |

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

### 36 V SINGLE SUPPLY

$V_{DD} = 36\ \text{V} \pm 10\%$ ,  $V_{SS} = 0\ \text{V}$ , GND = 0 V, unless otherwise noted.

Table 4.

| Parameter  | 25°C               | –40°C to +85°C | –40°C to +125°C | Unit   | Test Conditions/Comments  |
|--|--------------------|----------------|-----------------|--|---|
| <b>ANALOG SWITCH</b>                                     |                    |                |                 |  |   |
| Analogue Signal Range                                    |                    |                | 0 V to $V_{DD}$ | V max  |   |
| On Resistance, $R_{ON}$                                  | 150                |                |                 | $\Omega$ typ                                 | $V_S = 0\ \text{V}$ to 30 V, $I_S = -1\ \text{mA}$ , see Figure 25  |
| On-Resistance Match<br>Between Channels, $\Delta R_{ON}$ | 170<br>1.4         | 215            | 245             | $\Omega$ max<br>$\Omega$ typ                 | $V_{DD} = 32.4\ \text{V}$ , $V_{SS} = 0\ \text{V}$<br>$V_S = 0\ \text{V}$ to 30 V, $I_S = -1\ \text{mA}$                                  |
| On-Resistance Flatness, $R_{FLAT(ON)}$                   | 8<br>35<br>50      | 9<br>60        | 10<br>65        | $\Omega$ max<br>$\Omega$ typ<br>$\Omega$ max | $V_S = 0\ \text{V}$ to 30 V, $I_S = -1\ \text{mA}$  |
| <b>LEAKAGE CURRENTS</b>                                  |                    |                |                 |  |   |
| Source Off Leakage, $I_S$ (Off)                          | 0.01               |                |                 | nA typ                                       | $V_{DD} = 39.6\ \text{V}$ , $V_{SS} = 0\ \text{V}$<br>$V_S = 1\ \text{V}/30\ \text{V}$ , $V_D = 30\ \text{V}/1\ \text{V}$ , see Figure 27 |
| Drain Off Leakage, $I_D$ (Off)                           | 0.1<br>0.01        | 0.2            | 0.4             | nA max<br>nA typ                             | $V_S = 1\ \text{V}/30\ \text{V}$ , $V_D = 30\ \text{V}/1\ \text{V}$ , see Figure 27   |
| Channel On Leakage, $I_D$ (On), $I_S$ (On)               | 0.1<br>0.02<br>0.2 | 0.4<br>0.4     | 1.2<br>1.2      | nA max<br>nA typ<br>nA max                   | $V_S = V_D = 1\ \text{V}/30\ \text{V}$ , see Figure 24  |
| <b>DIGITAL INPUTS</b>                                    |                    |                |                 |  |   |
| Input High Voltage, $V_{INH}$                            |                    |                | 2.0             | V min  |   |
| Input Low Voltage, $V_{INL}$                             |                    |                | 0.8             | V max  |   |
| Input Current, $I_{INL}$ or $I_{INH}$                    | 0.002              |                | $\pm 0.1$       | $\mu\text{A}$ typ<br>$\mu\text{A}$ max       | $V_{IN} = V_{GND}$ or $V_{DD}$  |
| Digital Input Capacitance, $C_{IN}$                      | 3                  |                |                 | pF typ                                       |   |
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>               |                    |                |                 |  |   |
| Transition Time, $t_{TRANSITION}$                        | 180<br>250         | 275            | 305             | ns typ<br>ns max                             | $R_L = 300\ \Omega$ , $C_L = 35\ \text{pF}$<br>$V_S = 18\ \text{V}$ , see Figure 30   |
| $t_{ON}$   | 170<br>225         | 265            | 295             | ns typ<br>ns max                             | $R_L = 300\ \Omega$ , $C_L = 35\ \text{pF}$<br>$V_S = 18\ \text{V}$ , see Figure 32   |

| Parameter                           | 25°C | -40°C to +85°C | -40°C to +125°C | Unit        | Test Conditions/Comments                                     |
|-------------------------------------|------|----------------|-----------------|-------------|--|
| $t_{OFF}$                           | 170  |                |                 | ns typ      | $R_L = 300 \Omega$ , $C_L = 35$ pF                           |
|                                     | 215  | 215            | 225             | ns max      | $V_S = 18$ V, see Figure 32                                  |
| Break-Before-Make Time Delay, $t_D$ | 75   |                |                 | ns typ      | $R_L = 300 \Omega$ , $C_L = 35$ pF                           |
|                                     |      |                | 35              | ns min      | $V_{S1} = V_{S2} = 18$ V, see Figure 31                      |
| Charge Injection, $Q_{INJ}$         | -0.6 |                |                 | pC typ      | $V_S = 18$ V, $R_S = 0 \Omega$ , $C_L = 1$ nF, see Figure 33 |
| Off Isolation                       | -85  |                |                 | dB typ      | $R_L = 50 \Omega$ , $C_L = 5$ pF, $f = 1$ MHz, see Figure 28 |
| Channel-to-Channel Crosstalk        | -85  |                |                 | dB typ      | $R_L = 50 \Omega$ , $C_L = 5$ pF, $f = 1$ MHz, see Figure 26 |
| -3 dB Bandwidth                     | 266  |                |                 | MHz typ     | $R_L = 50 \Omega$ , $C_L = 5$ pF, see Figure 29              |
| Insertion Loss                      | -7   |                |                 | dB typ      | $R_L = 50 \Omega$ , $C_L = 5$ pF, $f = 1$ MHz, see Figure 29 |
| $C_S$ (Off)                         | 2.5  |                |                 | pF typ      | $V_S = 18$ V, $f = 1$ MHz                                    |
| $C_D$ (Off)                         | 12   |                |                 | pF typ      | $V_S = 18$ V, $f = 1$ MHz                                    |
| $C_D$ (On), $C_S$ (On)              | 15   |                |                 | pF typ      | $V_S = 18$ V, $f = 1$ MHz                                    |
| <b>POWER REQUIREMENTS</b>           |      |                |                 |             |  |
| $I_{DD}$                            | 85   |                |                 | $\mu$ A typ | $V_{DD} = 39.6$ V  |
|                                     | 100  |                | 130             | $\mu$ A max | Digital inputs = 0 V or $V_{DD}$                             |
| $V_{DD}$                            |      |                | 9/40            | V min/V max | GND = 0 V, $V_{SS} = 0$ V                                    |

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

## CONTINUOUS CURRENT PER CHANNEL, SxA, SxB, OR Dx

Table 5.

| Parameter                                       | 25°C | 85°C | 125°C | Unit   |
|---|------|------|-------|--------|
| <b>CONTINUOUS CURRENT, SxA, SxB, or Dx</b>      |      |      |       |        |
| $V_{DD} = +15$ V, $V_{SS} = -15$ V              |      |      |       |        |
| TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ ) | 19   | 7    | 2.8   | mA max |
| LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )  | 30   | 7.7  | 2.8   | mA max |
| $V_{DD} = +20$ V, $V_{SS} = -20$ V              |      |      |       |        |
| TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ ) | 21   | 7    | 2.8   | mA max |
| LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )  | 31   | 7.7  | 2.8   | mA max |
| $V_{DD} = 12$ V, $V_{SS} = 0$ V                 |      |      |       |        |
| TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ ) | 14   | 6.3  | 2.7   | mA max |
| LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )  | 22.5 | 7.3  | 2.8   | mA max |
| $V_{DD} = 36$ V, $V_{SS} = 0$ V                 |      |      |       |        |
| TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ ) | 24   | 7.4  | 2.8   | mA max |
| LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )  | 35   | 7.8  | 2.8   | mA max |



## ABSOLUTE MAXIMUM RATINGS

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

**Table 6.**

| Parameter   | Rating   |
|---|--|
| $V_{DD}$ to $V_{SS}$                                | 48 V   |
| $V_{DD}$ to GND                                     | -0.3 V to +48 V  |
| $V_{SS}$ to GND                                     | +0.3 V to -48 V  |
| Analog Inputs <sup>1</sup>                          | $V_{SS} - 0.3\text{ V}$ to $V_{DD} + 0.3\text{ V}$ or<br>30 mA, whichever occurs first |
| Digital Inputs <sup>1</sup>                         | $V_{SS} - 0.3\text{ V}$ to $V_{DD} + 0.3\text{ V}$ or<br>30 mA, whichever occurs first |
| Peak Current, SxA, SxB, or Dx<br>Pin                | 63 mA (pulsed at 1 ms,<br>10% duty cycle maximum)                                      |
| Continuous Current, SxA, SxB,<br>or Dx <sup>2</sup> | Data + 15%   |
| Temperature Range                                   |  |
| Operating   | -40°C to +125°C  |
| Storage   | -65°C to +150°C  |
| Junction Temperature                                | 150°C  |
| Thermal Impedance, $\theta_{JA}$                    |  |
| 16-Lead TSSOP (4-Layer<br>Board)                    | 112°C/W  |
| 16-Lead LFCSP                                       | 30.4°C/W   |
| Reflow Soldering Peak<br>Temperature, Pb Free       | 260(+0/-5)°C   |

<sup>1</sup> Overvoltages at the INx, SxA, SxB, and Dx pins are clamped by internal diodes. Limit the current to the maximum ratings given.

<sup>2</sup> See Table 5.

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

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

### ESD CAUTION



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

# PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

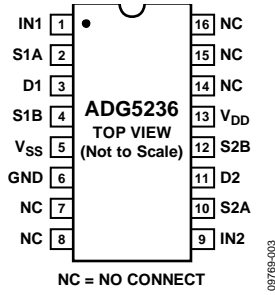
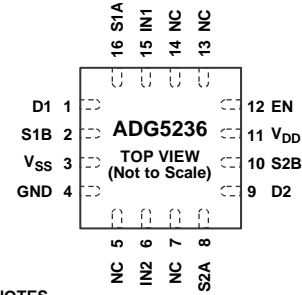


Figure 3. TSSOP Pin Configuration



NOTES  
 1. EXPOSED PAD TIED TO SUBSTRATE, V<sub>SS</sub>.  
 2. NC = NO CONNECT.

Figure 4. LFCSP Pin Configuration

Table 7. Pin Function Descriptions

| Pin No.          |              | Mnemonic        | Description   |
|------------------|--------------|-----------------|---|
| TSSOP            | LFCSP        |                 |   |
| 1                | 15           | IN1             | Logic Control Input 1.  |
| 2                | 16           | S1A             | Source Terminal 1A. This pin can be an input or output.   |
| 3                | 1            | D1              | Drain Terminal 1. This pin can be an input or output.   |
| 4                | 2            | S1B             | Source Terminal 1B. This pin can be an input or output.   |
| 5                | 3            | V <sub>SS</sub> | Most Negative Power Supply Potential.   |
| 6                | 4            | GND             | Ground (0 V) Reference.   |
| 7, 8, 14 to 16   | 5, 7, 13, 14 | NC              | No Connect. These pins are open.  |
| 9                | 6            | IN2             | Logic Control Input 2.  |
| 10               | 8            | S2A             | Source Terminal 2A. This pin can be an input or output.   |
| 11               | 9            | D2              | Drain Terminal 2. This pin can be an input or output.   |
| 12               | 10           | S2B             | Source Terminal 2B. This pin can be an input or output.   |
| 13               | 11           | V <sub>DD</sub> | Most Positive Power Supply Potential.   |
| N/A <sup>1</sup> | 12           | EN              | Active High Digital Input. When this pin is low, the device is disabled and all switches are off. When this pin is high, the IN <sub>x</sub> logic inputs determine the on switches.                                |
| N/A <sup>1</sup> | EP           | Exposed Pad     | Exposed Pad. The exposed pad is connected internally. For increased reliability of the solder joints and maximum thermal capability, it is recommended that the pad be soldered to the substrate, V <sub>SS</sub> . |

<sup>1</sup> N/A means not applicable.

## TRUTH TABLES FOR SWITCHES

Table 8. TSSOP Truth Table

| IN <sub>x</sub> | S <sub>x</sub> A | S <sub>x</sub> B |
|-----------------|------------------|------------------|
| 0               | Off              | On               |
| 1               | On               | Off              |

Table 9. LFCSP Truth Table

| EN | IN <sub>x</sub> | S <sub>x</sub> A | S <sub>x</sub> B |
|----|-----------------|------------------|------------------|
| 0  | X <sup>1</sup>  | Off              | Off              |
| 1  | 0               | Off              | On               |
| 1  | 1               | On               | Off              |

<sup>1</sup> X means don't care.

TYPICAL PERFORMANCE CHARACTERISTICS

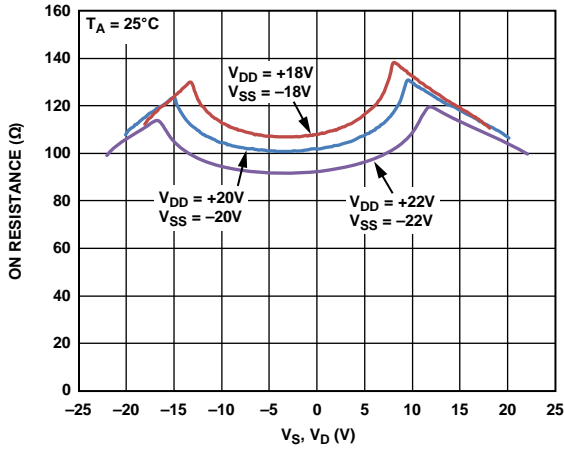


Figure 5. On Resistance vs.  $V_S$ ,  $V_D$  (Dual Supply)

09769-105

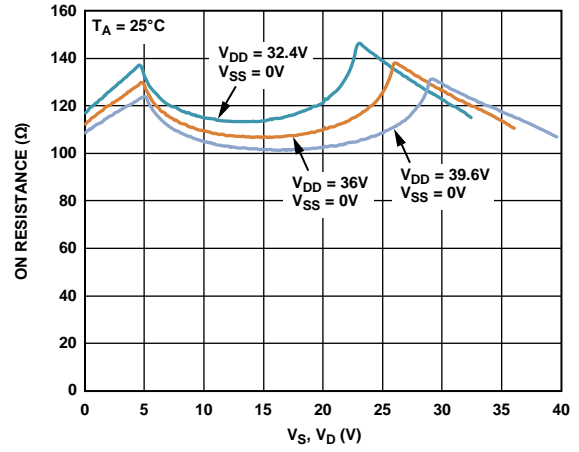


Figure 8. On Resistance vs.  $V_S$ ,  $V_D$  (Single Supply)

09769-108

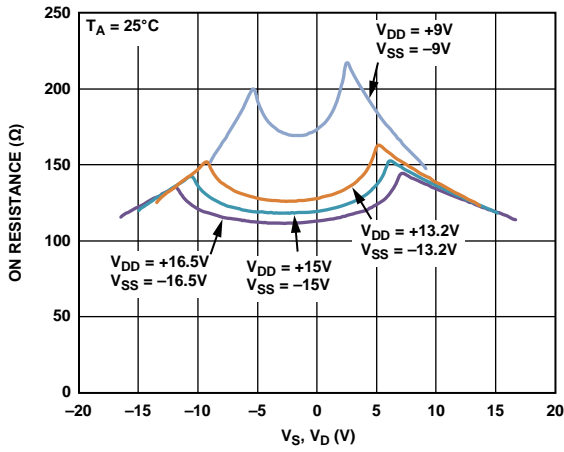


Figure 6. On Resistance vs.  $V_S$ ,  $V_D$  (Dual Supply)

09769-106

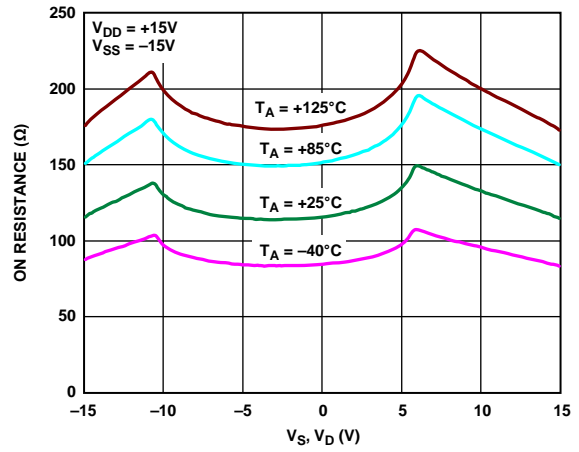


Figure 9. On Resistance vs.  $V_D$  or  $V_S$  for Different Temperatures,  $\pm 15$  V Dual Supply

09769-109

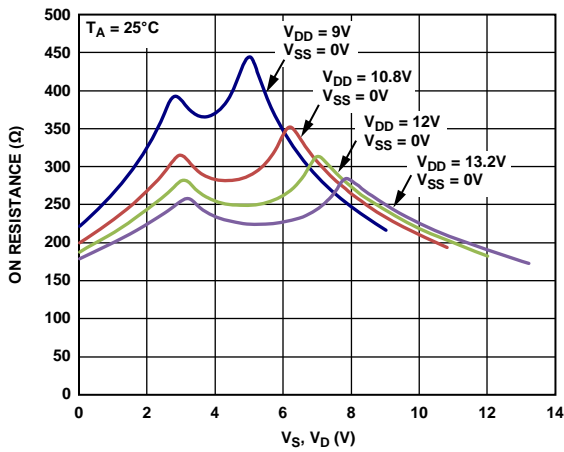


Figure 7. On Resistance vs.  $V_S$ ,  $V_D$  (Single Supply)

09769-107

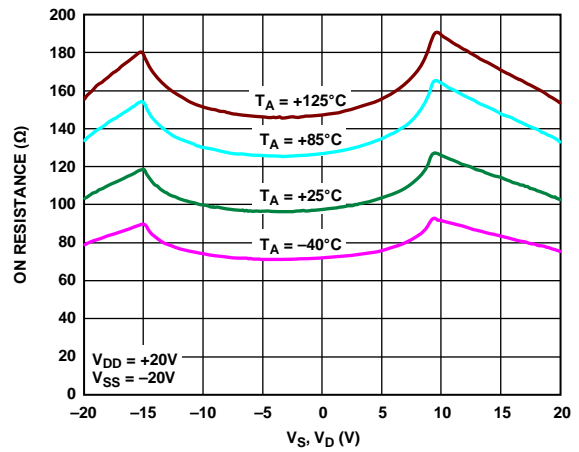


Figure 10. On Resistance vs.  $V_D$  or  $V_S$  for Different Temperatures,  $\pm 20$  V Dual Supply

09769-110

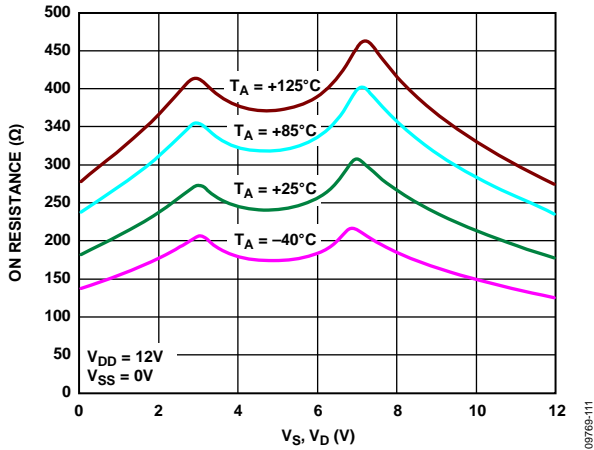


Figure 11. On Resistance vs.  $V_D$  or  $V_S$  for Different Temperatures, 12 V Single Supply

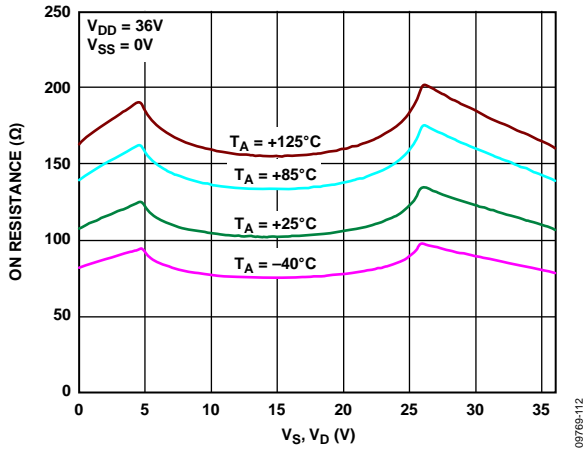


Figure 12. On Resistance vs.  $V_S$  or  $V_D$  for Different Temperatures, 36 V Single Supply

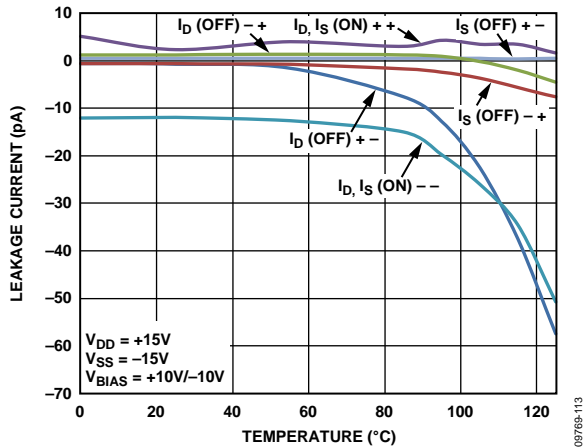


Figure 13. Leakage Current vs. Temperature,  $\pm 15$  V Dual Supply

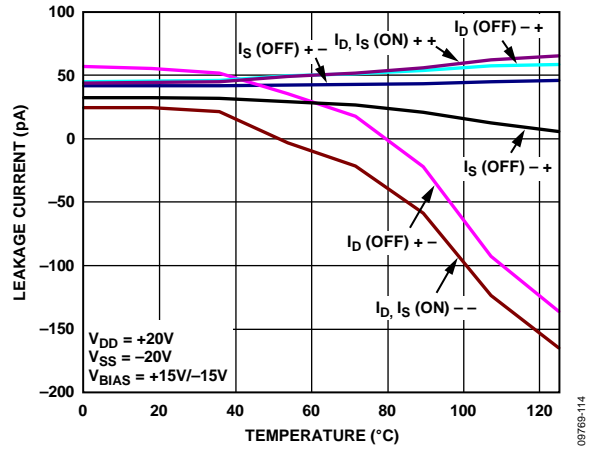


Figure 14. Leakage Current vs. Temperature,  $\pm 20$  V Single Supply

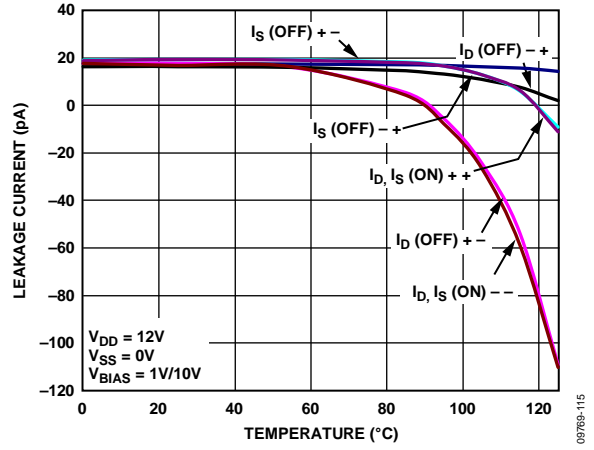


Figure 15. Leakage Current vs. Temperature, 12 V Single Supply

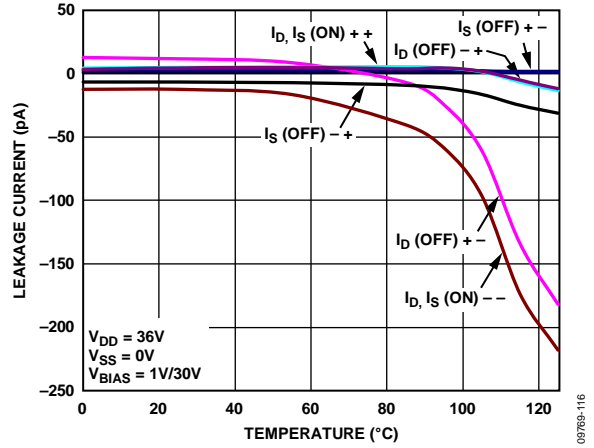


Figure 16. Leakage Current vs. Temperature, 36 V Single Supply

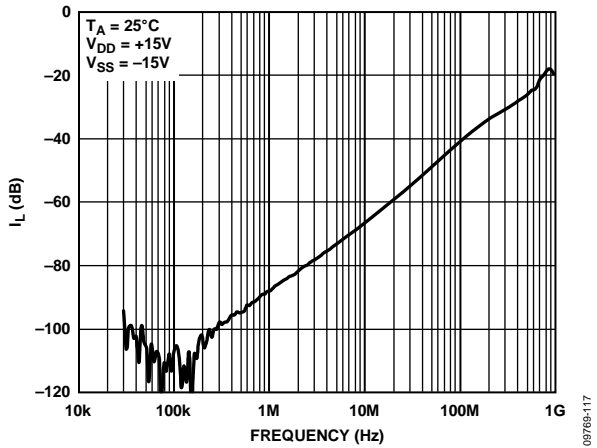


Figure 17. Off Isolation vs. Frequency

09769-117

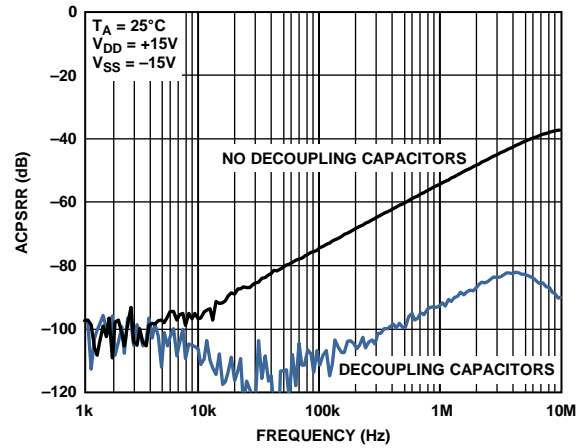


Figure 20. ACPSRR vs. Frequency

09769-120

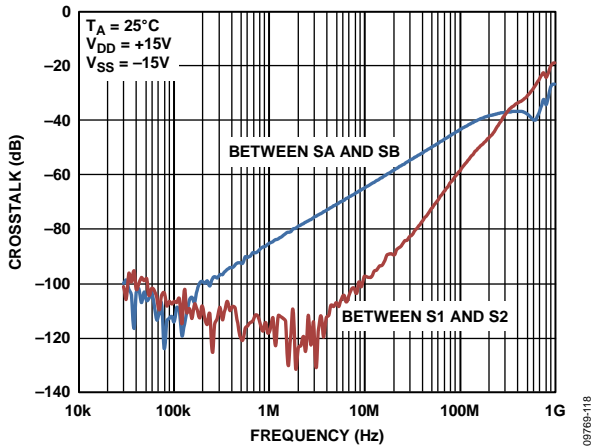


Figure 18. Crosstalk vs. Frequency

09769-118

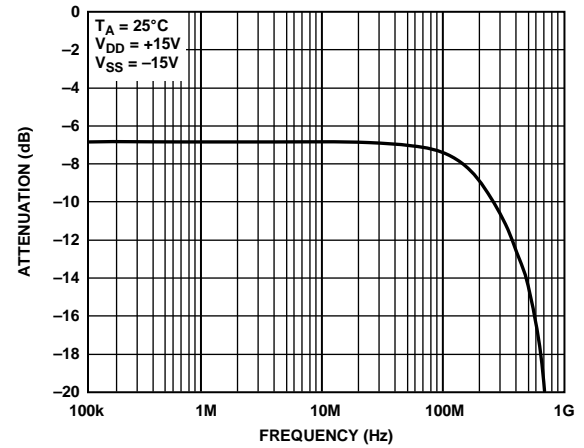


Figure 21. Bandwidth

09769-122

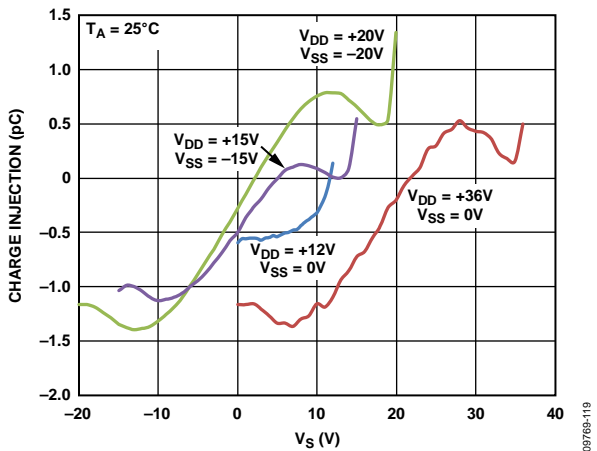


Figure 19. Charge Injection vs. Source Voltage

09769-119

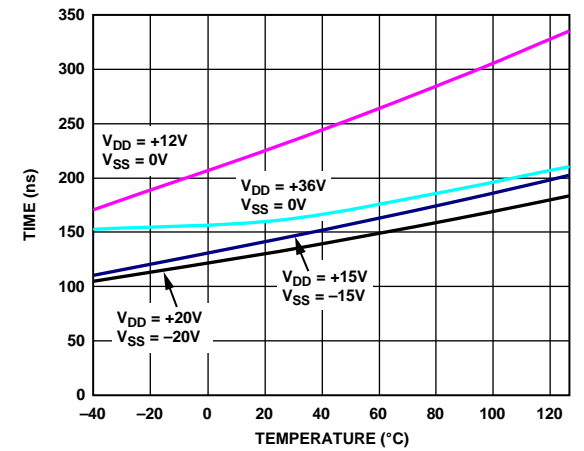


Figure 22.  $t_{\text{TRANSITION}}$  Time vs. Temperature

09769-123

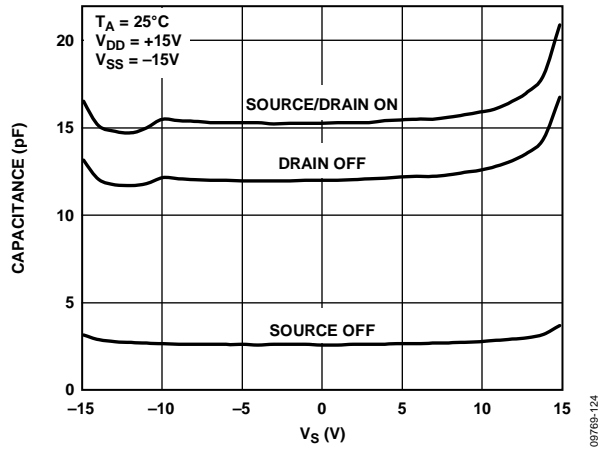


Figure 23. Capacitance vs. Source Voltage, Dual Supply

TEST CIRCUITS

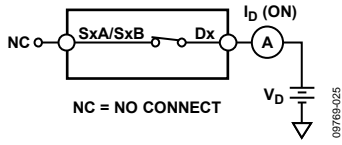


Figure 24. On Leakage

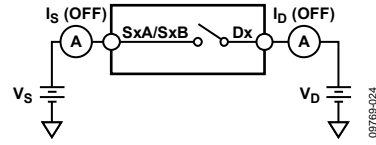


Figure 27. Off Leakage

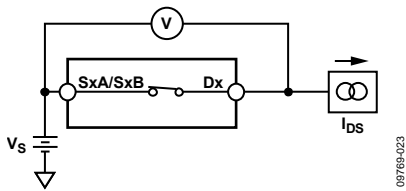


Figure 25. On Resistance

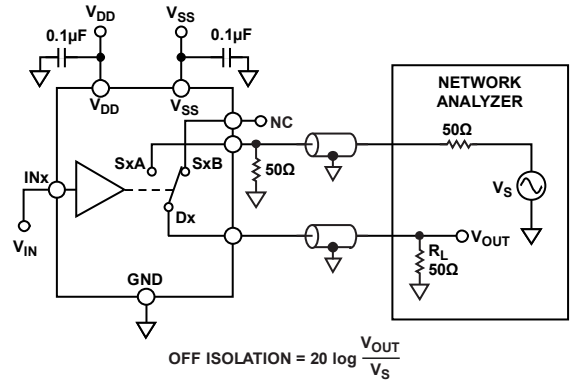


Figure 28. Off Isolation

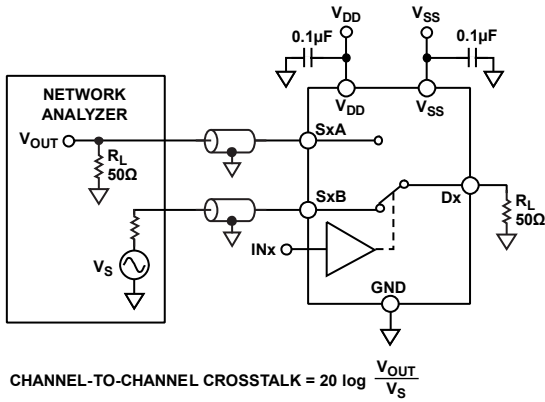


Figure 26. Channel-to-Channel Crosstalk

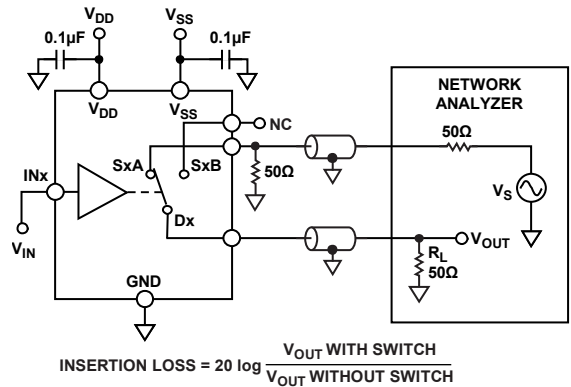


Figure 29. Bandwidth

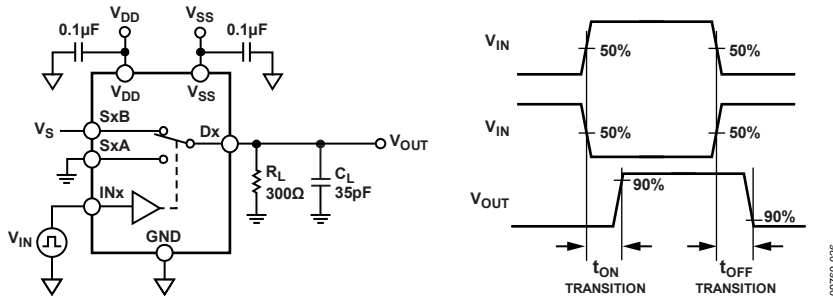


Figure 30. Switching Times

09769-026

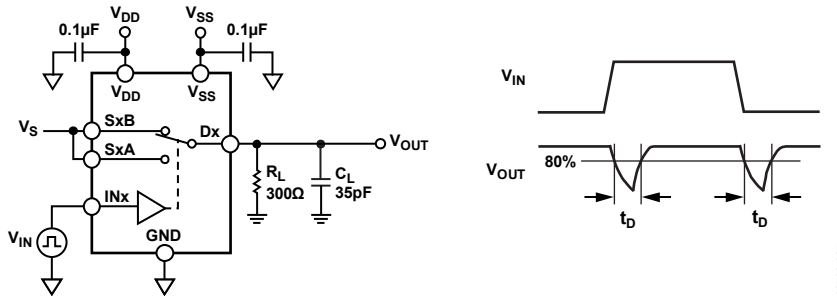


Figure 31. Break-Before-Make Time Delay  $t_d$

09769-027

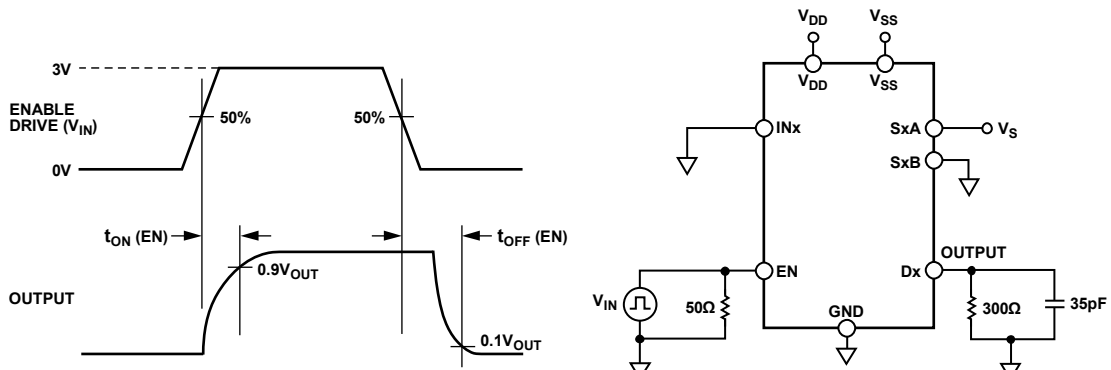


Figure 32. Enable Delay,  $t_{ON}(EN)$ ,  $t_{OFF}(EN)$

09769-028

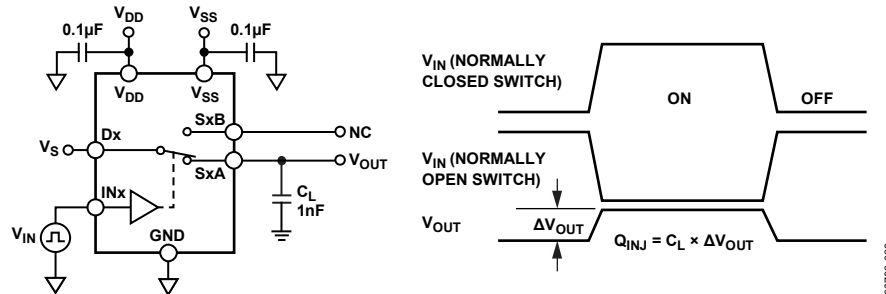


Figure 33. Charge Injection

09769-029



## TERMINOLOGY

### $I_{DD}$

$I_{DD}$  represents the positive supply current.

### $I_{SS}$

$I_{SS}$  represents the negative supply current.

### $V_D, V_S$

$V_D$  and  $V_S$  represent the analog voltage on Terminal D and Terminal S, respectively.

### $R_{ON}$

$R_{ON}$  represents the ohmic resistance between Terminal D and Terminal S.

### $\Delta R_{ON}$

$\Delta R_{ON}$  represents the difference between the  $R_{ON}$  of any two channels.

### $R_{FLAT(ON)}$

Flatness that is defined as the difference between the maximum and minimum value of on resistance measured over the specified analog signal range is represented by  $R_{FLAT(ON)}$ .

### $I_S$ (Off)

$I_S$  (Off) is the source leakage current with the switch off.

### $I_D$ (Off)

$I_D$  (Off) is the drain leakage current with the switch off.

### $I_D$ (On), $I_S$ (On)

$I_D$  (On) and  $I_S$  (On) represent the channel leakage currents with the switch on.

### $V_{INL}$

$V_{INL}$  is the maximum input voltage for Logic 0.

### $V_{INH}$

$V_{INH}$  is the minimum input voltage for Logic 1.

### $I_{INL}, I_{INH}$

$I_{INL}$  and  $I_{INH}$  represent the low and high input currents of the digital inputs.

### $C_D$ (Off)

$C_D$  (Off) represents the off switch drain capacitance, which is measured with reference to ground.

### $C_S$ (Off)

$C_S$  (Off) represents the off switch source capacitance, which is measured with reference to ground.

### $C_D$ (On), $C_S$ (On)

$C_D$  (On) and  $C_S$  (On) represent on switch capacitances, which are measured with reference to ground.

### $C_{IN}$

$C_{IN}$  is the digital input capacitance.

### $t_{ON}$

$t_{ON}$  represents the delay between applying the digital control input and the output switching on.

### $t_{OFF}$

$t_{OFF}$  represents the delay between applying the digital control input and the output switching off.

### $t_D$

$t_D$  represents the off time measured between the 80% point of both switches when switching from one address state to another.

### Off Isolation

Off isolation is a measure of unwanted signal coupling through an off switch.

### Charge Injection

Charge injection is a measure of the glitch impulse transferred from the digital input to the analog output during switching.

### Crosstalk

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

### Bandwidth

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

### On Response

On response is the frequency response of the on switch.

### Insertion Loss

Insertion loss is the loss due to the on resistance of the switch.

### AC Power Supply Rejection Ratio (ACPSRR)

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

## TRENCH ISOLATION

In the [ADG5236](#), an insulating oxide layer (trench) is placed between the NMOS and the PMOS transistors of each CMOS switch. Parasitic junctions, which occur between the transistors in junction isolated switches, are eliminated, and the result is a completely latch-up proof switch.

In junction isolation, the N and P wells of the PMOS and NMOS transistors form a diode that is reverse-biased under normal operation. However, during overvoltage conditions, this diode can become forward-biased. A silicon controlled rectifier (SCR) type circuit is formed by the two transistors causing a significant amplification of the current that, in turn, leads to latch-up. With trench isolation, this diode is removed, and the result is a latch-up proof switch.

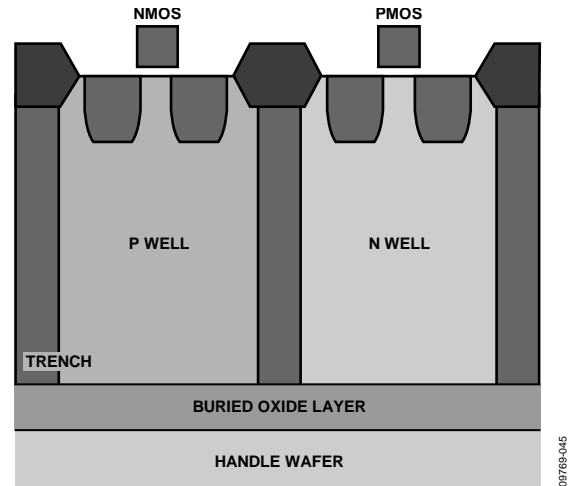
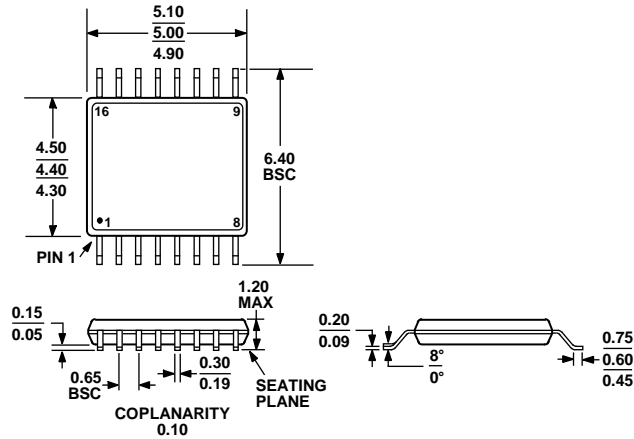


Figure 34. Trench Isolation

## APPLICATIONS INFORMATION

The ADG52xx family of switches and multiplexers provide a robust solution for instrumentation, industrial, automotive, aerospace, and other harsh environments that are prone to latch-up, which is an undesirable high current state that can lead to device failure and persists until the power supply is turned off. The [ADG5236](#) high voltage switches allow single-supply operation from 9 V to 40 V and dual supply operation from  $\pm 9$  V to  $\pm 22$  V.

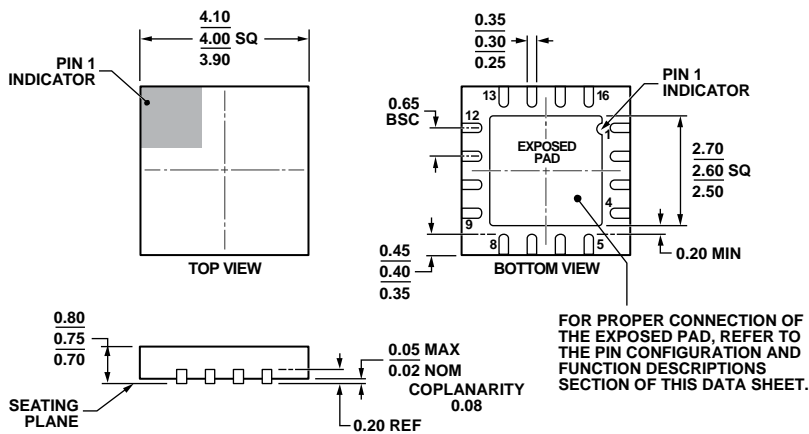
### OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AB

Figure 35. 16-Lead Thin Shrink Small Outline Package [TSSOP] (RU-16)

Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-220-WGGC.

Figure 36. 16-Lead Lead Frame Chip Scale Package [LFCSP\_WQ] 4 mm x 4 mm Body, Very Very Thin Quad (CP-16-17)

Dimensions shown in millimeters

08-16-2010-C

### ORDERING GUIDE

| Model <sup>1</sup> | Temperature Range | Package Description                               | Package Option |
|--------------------|-------------------|---|----------------|
| ADG5236BRUZ        | -40°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |
| ADG5236BRUZ-RL7    | -40°C to +125°C   | 16-Lead Thin Shrink Small Outline Package [TSSOP] | RU-16          |
| ADG5236BCPZ-RL7    | -40°C to +125°C   | 16-Lead Lead Frame Chip Scale Package [LFCSP_WQ]  | CP-16-17       |

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

**NOTES**