

**ADG819/ADG820****FEATURES**

Low On Resistance 0.8  $\Omega$  Max at 125°C  
0.25  $\Omega$  Max On Resistance Flatness  
1.8 V to 5.5 V Single Supply  
200 mA Current Carrying Capability  
Automotive Temperature Range: -40°C to +125°C  
Rail-to-Rail Operation  
6-Lead SOT-23 Package, 8-Lead  $\mu$ SOIC Package, and  
6-Bump MicroCSP (Micro Chip Scale Package) ADG819  
Fast Switching Times  
Typical Power Consumption (<0.01  $\mu$ W)  
TTL-/CMOS-Compatible Inputs  
Pin Compatible with the ADG719 (ADG819)

**APPLICATIONS**

Power Routing  
Battery-Powered Systems  
Communication Systems  
Data Acquisition Systems  
Cellular Phones  
Modems  
PCMCIA Cards  
Hard Drives  
Relay Replacement

**GENERAL DESCRIPTION**

The ADG819 and the ADG820 are monolithic, CMOS, SPDT (single-pole, double-throw) switches. These switches are designed on a submicron process that provides low power dissipation yet gives high switching speed, low On resistance, and low leakage currents.

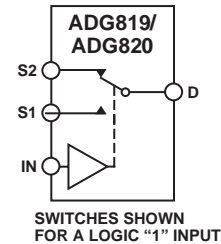
Low power consumption and an operating supply range of 1.8 V to 5.5 V make the ADG819 and ADG820 ideal for battery-powered, portable instruments.

Each switch of the ADG819 and the ADG820 conducts equally well in both directions when on. The ADG819 exhibits break-before-make switching action, thus preventing momentary shorting when switching channels. The ADG820 exhibits make-before-break action.

The ADG819 and the ADG820 are available in a 6-lead SOT-23 package and an 8-lead  $\mu$ SOIC package. The ADG819 is also available in a 2  $\times$  3 bump 1.14 mm  $\times$  2.18 mm MicroCSP package. This chip occupies only a 1.14 mm  $\times$  2.18 mm area, making it the ideal candidate for space-constrained applications.

REV. 0

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**FUNCTIONAL BLOCK DIAGRAM****PRODUCT HIGHLIGHTS**

1. Very low ON resistance, 0.5  $\Omega$  typical
2. 1.8 V to 5.5 V single-supply operation
3. High current carrying capability
4. Tiny 6-lead SOT-23 package, 8-lead  $\mu$ SOIC package, and 2  $\times$  3 bump 1.14 mm  $\times$  2.18 mm MicroCSP package (ADG819 only)

# ADG819/ADG820—SPECIFICATIONS<sup>1</sup> ( $V_{DD} = 5\text{ V} \pm 10\%$ , $GND = 0\text{ V}$ )

| Parameter  | 25°C                     | -40°C to +85°C | -40°C to +125°C <sup>2</sup> | Unit                                   | Test Conditions/Comments   |
|--|--------------------------|----------------|------------------------------|--|--|
| <b>ANALOG SWITCH</b>                                     |                          |                |                              |  |  |
| Analog Signal Range                                      |                          |                | 0 V to $V_{DD}$              | V                                      |  |
| ON Resistance ( $R_{ON}$ )                               | 0.5<br>0.6               | 0.7            | 0.8                          | $\Omega$ typ<br>$\Omega$ max           | $V_S = 0\text{ V}$ to $V_{DD}$ , $I_S = 100\text{ mA}$ ;<br>Test Circuit 1                                       |
| ON Resistance Match Between Channels ( $\Delta R_{ON}$ ) | 0.06<br>0.08             | 0.1            | 0.12                         | $\Omega$ typ<br>$\Omega$ max           | $V_S = 0\text{ V}$ to $V_{DD}$ , $I_S = 100\text{ mA}$   |
| ON Resistance Flatness ( $R_{FLAT(ON)}$ )                | 0.1<br>0.17              | 0.2            | 0.25                         | $\Omega$ typ<br>$\Omega$ max           | $V_S = 0\text{ V}$ to $V_{DD}$ , $I_S = 100\text{ mA}$   |
| <b>LEAKAGE CURRENTS</b>                                  |                          |                |                              |  |  |
| Source OFF Leakage $I_S$ (OFF)                           | $\pm 0.01$<br>$\pm 0.25$ | $\pm 3$        | $\pm 10$                     | nA typ<br>nA max                       | $V_{DD} = 5.5\text{ V}$<br>$V_S = 4.5\text{ V}/1\text{ V}$ , $V_D = 1\text{ V}/4.5\text{ V}$ ;<br>Test Circuit 2 |
| Channel ON Leakage $I_D$ , $I_S$ (ON)                    | $\pm 0.01$<br>$\pm 0.25$ | $\pm 3$        | $\pm 25$                     | nA typ<br>nA max                       | $V_S = V_D = 1\text{ V}$ , or $V_S = V_D = 4.5\text{ V}$ ;<br>Test Circuit 3                                     |
| <b>DIGITAL INPUTS</b>                                    |                          |                |                              |  |  |
| Input High Voltage, $V_{INH}$                            |                          |                | 2.0                          | V min                                  |  |
| Input Low Voltage, $V_{INL}$                             |                          |                | 0.8                          | V max                                  |  |
| Input Current<br>$I_{INL}$ or $I_{INH}$                  | 0.005                    |                | $\pm 0.1$                    | $\mu\text{A}$ typ<br>$\mu\text{A}$ max | $V_{IN} = V_{INL}$ or $V_{INH}$  |
| $C_{IN}$ , Digital Input Capacitance                     | 5                        |                |                              | pF typ                                 |  |
| <b>DYNAMIC CHARACTERISTICS<sup>3</sup></b>               |                          |                |                              |  |  |
| <b>ADG819</b>  |                          |                |                              |  |  |
| $t_{ON}$   | 35<br>45                 | 50             | 55                           | ns typ<br>ns max                       | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_S = 3\text{ V}$ ; Test Circuit 4                               |
| $t_{OFF}$  | 10<br>16                 | 18             | 21                           | ns typ<br>ns max                       | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_S = 3\text{ V}$ ; Test Circuit 4                               |
| Break-Before-Make Time Delay, $t_{BBM}$                  | 5                        |                | 1                            | ns typ<br>ns min                       | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_{S1} = V_{S2} = 3\text{ V}$ ; Test Circuit 5                   |
| <b>ADG820</b>  |                          |                |                              |  |  |
| $t_{ON}$   | 10<br>18                 | 20             | 22                           | ns typ<br>ns max                       | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_S = 3\text{ V}$ ; Test Circuit 4                               |
| $t_{OFF}$  | 26<br>40                 | 45             | 50                           | ns typ<br>ns max                       | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_S = 3\text{ V}$ ; Test Circuit 4                               |
| Make-Before-Break Time Delay, $t_{MBB}$                  | 15                       |                | 1                            | ns typ<br>ns min                       | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_S = 0\text{ V}$ ; Test Circuit 6                               |
| Charge Injection   | 20                       |                |                              | pC typ                                 | $V_S = 2.5\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ;<br>Test Circuit 7                               |
| Off Isolation  | -71                      |                |                              | dB typ                                 | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ ;<br>Test Circuit 8                              |
| Channel-to-Channel Crosstalk                             | -72                      |                |                              | dB typ                                 | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ ;<br>Test Circuit 10                             |
| Bandwidth -3 dB  | 17                       |                |                              | MHz typ                                | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; Test Circuit 9  |
| $C_S$ (OFF)  | 80                       |                |                              | pF typ                                 | $f = 1\text{ MHz}$   |
| $C_D$ , $C_S$ (ON)                                       | 300                      |                |                              | pF typ                                 | $f = 1\text{ MHz}$   |
| <b>POWER REQUIREMENTS</b>                                |                          |                |                              |  |  |
| $I_{DD}$   | 0.001                    | 1.0            | 2.0                          | $\mu\text{A}$ typ<br>$\mu\text{A}$ max | $V_{DD} = 5.5\text{ V}$<br>Digital Inputs = 0 V or 5.5 V   |

## NOTES

<sup>1</sup>Temperature range is as follows: -40°C to +125°C.

<sup>2</sup>ON resistance parameters tested with  $I_S = 10\text{ mA}$ .

<sup>3</sup>Guaranteed by design, not subject to production test.

Specifications subject to change without notice.

# SPECIFICATIONS<sup>1</sup> ( $V_{DD} = 2.7\text{ V to }3.6\text{ V, GND} = 0\text{ V.}$ )

| Parameter  | 25°C                     | -40°C to +85°C | -40°C to +125°C <sup>2</sup> | Unit                                   | Test Conditions/Comments   |
|--|--------------------------|----------------|------------------------------|--|--|
| <b>ANALOG SWITCH</b>                                     |                          |                |                              |  |  |
| Analog Signal Range                                      |                          |                | 0 V to $V_{DD}$              | V                                      |  |
| ON Resistance ( $R_{ON}$ )                               | 0.7                      |                |                              | $\Omega$ typ<br>$\Omega$ max           | $V_S = 0\text{ V to }V_{DD}$ , $I_S = 100\text{ mA}$ ;<br>Test Circuit 1   |
| ON Resistance Match Between Channels ( $\Delta R_{ON}$ ) | 0.06                     | 1.5            | 1.6                          | $\Omega$ typ<br>$\Omega$ max           | $V_S = 0\text{ V to }V_{DD}$ , $I_S = 100\text{ mA}$   |
| ON Resistance Flatness ( $R_{FLAT(ON)}$ )                | 0.25                     | 0.13           | 0.13                         | $\Omega$ typ                           | $V_S = 0\text{ V to }V_{DD}$ , $I_S = 100\text{ mA}$   |
| <b>LEAKAGE CURRENTS</b>                                  |                          |                |                              |  |  |
| Source OFF Leakage $I_S$ (OFF)                           | $\pm 0.01$<br>$\pm 0.25$ | $\pm 3$        | $\pm 10$                     | nA typ<br>nA max                       | $V_{DD} = 3.6\text{ V}$<br>$V_S = 3.3\text{ V}/1\text{ V}$ , $V_D = 1\text{ V}/3.3\text{ V}$ ;<br>Test Circuit 2 |
| Channel ON Leakage $I_D$ , $I_S$ (ON)                    | $\pm 0.01$<br>$\pm 0.25$ | $\pm 3$        | $\pm 25$                     | nA typ<br>nA max                       | $V_S = V_D = 1\text{ V}$ , or $V_S = V_D = 3.3\text{ V}$ ;<br>Test Circuit 3                                     |
| <b>DIGITAL INPUTS</b>                                    |                          |                |                              |  |  |
| Input High Voltage, $V_{INH}$                            |                          |                | 2.0                          | V min                                  |  |
| Input Low Voltage, $V_{INL}$                             |                          |                | 0.8                          | V max                                  |  |
| Input Current<br>$I_{INL}$ or $I_{INH}$                  | 0.005                    |                | $\pm 0.1$                    | $\mu\text{A}$ typ<br>$\mu\text{A}$ max | $V_{IN} = V_{INL}$ or $V_{INH}$  |
| $C_{IN}$ , Digital Input Capacitance                     | 5                        |                |                              | pF typ                                 |  |
| <b>DYNAMIC CHARACTERISTICS<sup>3</sup></b>               |                          |                |                              |  |  |
| <b>ADG819</b>  |                          |                |                              |  |  |
| $t_{ON}$   | 40                       |                |                              | ns typ                                 | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_S = 1.5\text{ V}$ ; Test Circuit 4                             |
|  | 60                       | 65             | 70                           | ns max                                 |  |
| $t_{OFF}$  | 10                       |                |                              | ns typ                                 | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_S = 1.5\text{ V}$ ; Test Circuit                               |
|  | 16                       | 18             | 21                           | ns max                                 |  |
| Break-Before-Make Time Delay, $t_{BBM}$                  | 40                       |                |                              | ns typ                                 | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_{S1} = V_{S2} = 1.5\text{ V}$ ; Test Circuit 5                 |
|  |                          |                | 1                            | ns min                                 |  |
| <b>ADG820</b>  |                          |                |                              |  |  |
| $t_{ON}$   | 20                       |                |                              | ns typ                                 | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_S = 1.5\text{ V}$ ; Test Circuit 4                             |
|  | 35                       | 40             | 45                           | ns max                                 |  |
| $t_{OFF}$  | 30                       |                |                              | ns typ                                 | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_S = 1.5\text{ V}$ ; Test Circuit 4                             |
|  | 45                       | 50             | 55                           | ns max                                 |  |
| Make-Before-Break Time Delay, $t_{MKB}$                  | 10                       |                |                              | ns typ                                 | $R_L = 50\ \Omega$ , $C_L = 35\text{ pF}$ ,<br>$V_S = 1.5\text{ V}$ ; Test Circuit 6                             |
|  |                          |                | 1                            | ns min                                 |  |
| Charge Injection   | 10                       |                |                              | pC typ                                 | $V_S = 1.5\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ;<br>Test Circuit 7                               |
| Off Isolation  | -71                      |                |                              | dB typ                                 | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ ;<br>Test Circuit 8                              |
| Channel-to-Channel Crosstalk                             | -72                      |                |                              | dB typ                                 | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ ;<br>Test Circuit 10                             |
| Bandwidth -3 dB  | 17                       |                |                              | MHz typ                                | $R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; Test Circuit 9  |
| $C_S$ (OFF)  | 80                       |                |                              | pF typ                                 | $f = 1\text{ MHz}$   |
| $C_D$ , $C_S$ (ON)                                       | 300                      |                |                              | pF typ                                 | $f = 1\text{ MHz}$   |
| <b>POWER REQUIREMENTS</b>                                |                          |                |                              |  |  |
| $I_{DD}$   | 0.001                    |                |                              | $\mu\text{A}$ typ<br>$\mu\text{A}$ max | $V_{DD} = 3.6\text{ V}$<br>Digital Inputs = 0 V or 3.6 V   |
|  |                          | 1.0            | 2.0                          |  |  |

## NOTES

<sup>1</sup>Temperature range is as follows: -40°C to +125°C.<sup>2</sup>ON resistance parameters tested with  $I_S = 10\text{ mA}$ .<sup>3</sup>Guaranteed by design, not subject to production test.

Specifications subject to change without notice.

# ADG819/ADG820

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

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

|                                   |   |
|-----------------------------------|---|
| V <sub>DD</sub> to GND            | -0.3 V to +7 V  |
| Analog Inputs <sup>2</sup>        | -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              | 400 mA<br>(Pulsed at 1 ms, 10% Duty Cycle Max)                        |
| Continuous Current, S or D        | 200 mA  |
| Operating Temperature Range       |   |
| Industrial                        | -40°C to +85°C  |
| Automotive                        | -40°C to +125°C   |
| Storage Temperature Range         | -65°C to +150°C   |
| Junction Temperature              | 150°C   |
| μSOIC Package                     |   |
| θ <sub>JA</sub> Thermal Impedance | 206°C/W   |
| θ <sub>JC</sub> Thermal Impedance | 44°C/W  |
| SOT-23 Package (4-Layer Board)    |   |
| θ <sub>JA</sub> Thermal Impedance | 119°C/W   |

## MicroCSP Package

|                                       |       |
|---------------------------------------|-------|
| θ <sub>JA</sub> Thermal Impedance     | TBD   |
| Lead Temperature, Soldering (10 sec)  | 300°C |
| IR Reflow, Peak Temperature (<20 sec) | 235°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 IN, S, or D will be clamped by internal diodes. Current should be limited to the maximum ratings given.

**Table I. Truth Table for the ADG819/ADG820**

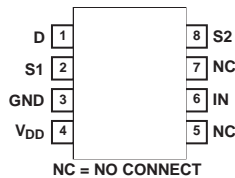
| IN | Switch S1 | Switch S2 |
|----|-----------|-----------|
| 0  | ON        | OFF       |
| 1  | OFF       | ON        |

## PIN CONFIGURATIONS

### 6-Lead SOT-23 (RJ-6)



### 8-Lead μSOIC (RM-8)



### 2 × 3 MicroCSP



## ORDERING GUIDE

| Model Option | Temperature Range | Brand <sup>1</sup> | Package Description                 | Package           |
|--------------|-------------------|--------------------|-------------------------------------|-------------------|
| ADG819BRM    | -40°C to +125°C   | SNB                | μSOIC (MicroSmall Outline IC)       | RM-8              |
| ADG819BRT    | -40°C to +125°C   | SNB                | SOT-23 (Plastic Surface-Mount)      | RJ-6 <sup>2</sup> |
| ADG819BCB    | -40°C to +85°C    | SNB                | MicroCSP (Micro Chip Scale Package) | CB-6 <sup>2</sup> |
| ADG820BRM    | -40°C to +125°C   | SPB                | μSOIC (MicroSmall Outline IC)       | RM-8              |
| ADG820BRT    | -40°C to +125°C   | SPB                | SOT-23 (Plastic Surface-Mount)      | RJ-6 <sup>2</sup> |

## NOTES

<sup>1</sup>Branding on these packages is limited to three characters due to space constraints.

<sup>2</sup>Contact factory for availability.

## TERMINOLOGY

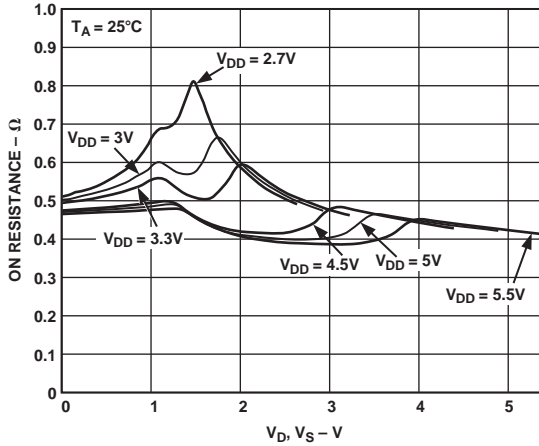
|                         |  |
|-------------------------|--|
| $V_{DD}$                | Most Positive Power Supply Potential   |
| GND                     | Ground (0 V) Reference   |
| $I_{DD}$                | Positive Supply Current  |
| S                       | Source Terminal. May be an input or output.  |
| D                       | Drain Terminal. May be an input or output.   |
| IN                      | Logic Control Input  |
| $R_{ON}$                | Ohmic Resistance between D and S   |
| $\Delta R_{ON}$         | ON Resistance Match between Any Two Channels, i.e., $R_{ON\ max} - R_{ON\ min}$  |
| $R_{FLAT(ON)}$          | Flatness is defined as the difference between the maximum and minimum value of ON resistance as measured over the specified analog signal range. |
| $I_S$ (OFF)             | Source Leakage Current with the Switch OFF   |
| $I_D, I_S$ (ON)         | Channel Leakage Current with the Switch ON   |
| $V_D$ ( $V_S$ )         | Analog Voltage on Terminals D, S   |
| $V_{INL}$               | 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  |
| $C_D, C_S$ (ON)         | ON Switch Capacitance  |
| $t_{ON}$                | Delay between applying the digital control input and the output switching ON.  |
| $t_{OFF}$               | Delay between applying the digital control input and the output switching OFF.   |
| $t_{BBM}$               | OFF time or ON time measured between the 90% points of both switches when switching from one address state to another.                           |
| $t_{MBB}$               | ON time measured between the 80% points of both switches when switching from one address state to another.                                       |
| Charge Injection        | A measure of the glitch impulse transferred from the digital input to the analog output during switching.  |
| Crosstalk               | A measure of unwanted signal coupled through from one channel to another as a result of parasitic capacitance.                                   |
| OFF Isolation           | A measure of unwanted signal coupling through an OFF switch.   |
| Bandwidth               | Frequency at which the output is attenuated by -3 dB.  |
| ON Response             | Frequency Response of the ON Switch  |
| Insertion Loss          | Loss due to the ON Resistance of the Switch  |

**CAUTION**

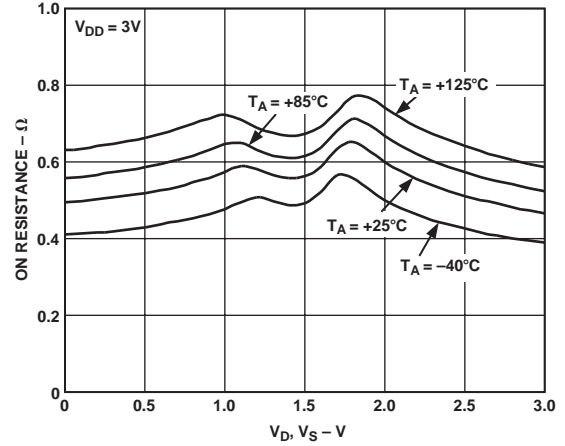
ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the ADG819/ADG820 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



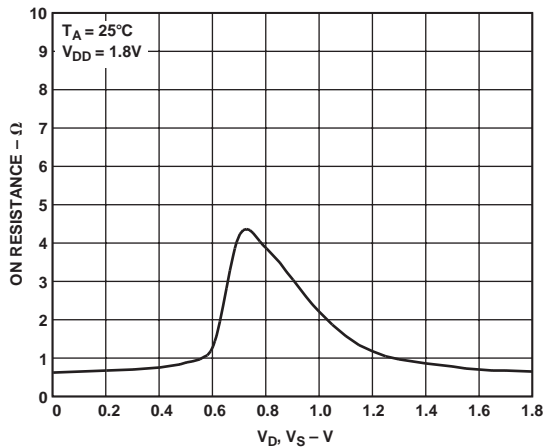
# ADG819/ADG820 – Typical Performance Characteristics



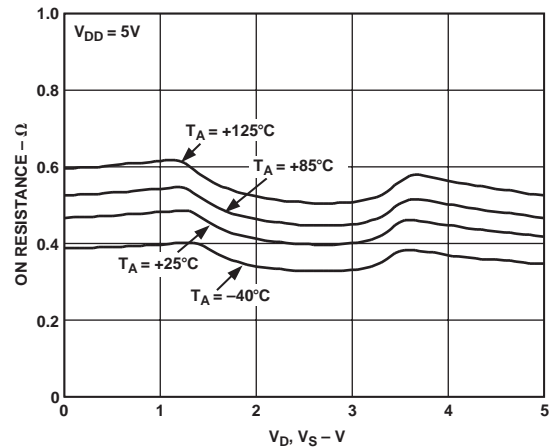
TPC 1. ON Resistance vs.  $V_D$  ( $V_S$ )



TPC 4. ON Resistance vs.  $V_D$  ( $V_S$ ) for Different Temperatures



TPC 2. ON Resistance vs.  $V_D$  ( $V_S$ )



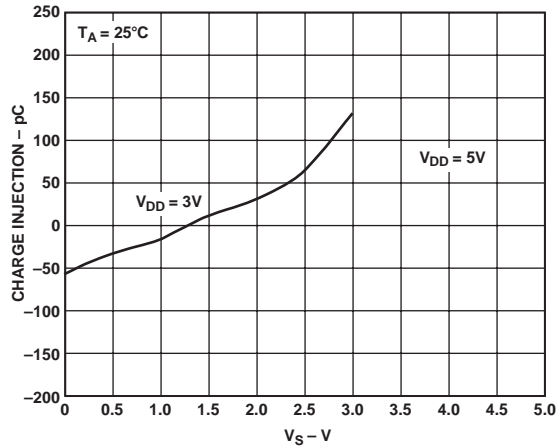
TPC 5. ON Resistance vs.  $V_D$  ( $V_S$ ) for Different Temperatures



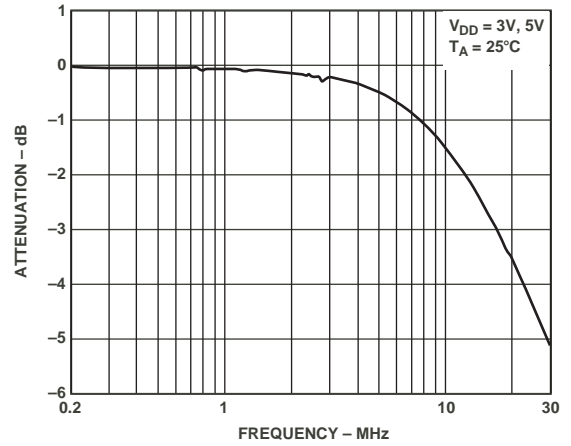
TPC 3. Leakage Currents vs. Temperatures



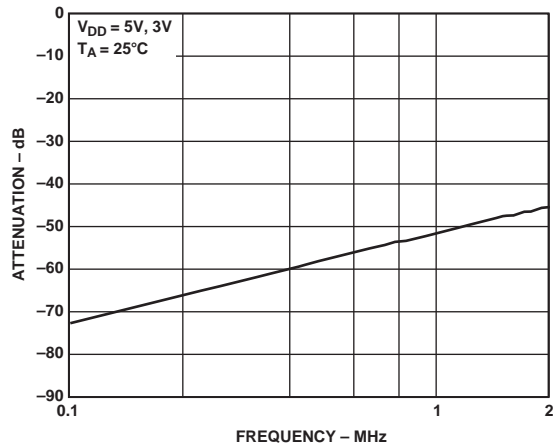
TPC 6.  $t_{ON}/t_{OFF}$  Times vs. Temperature (ADG819)



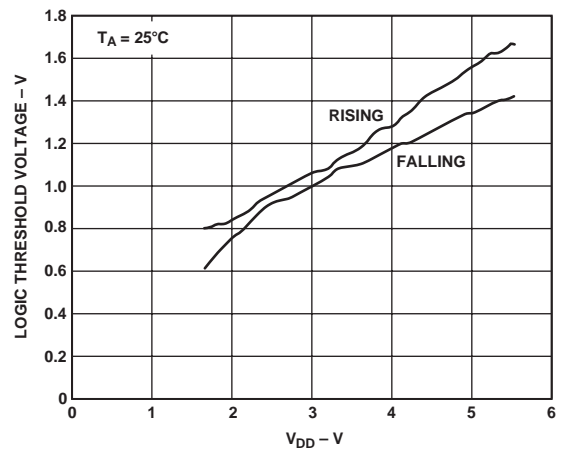
TPC 7. Charge Injection vs. Source Voltage



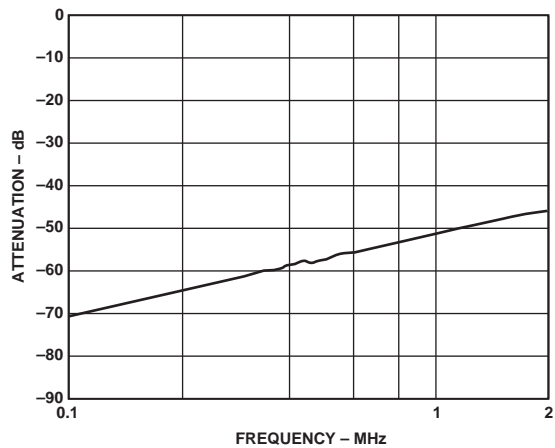
TPC 10. ON Response vs. Frequency



TPC 8. OFF Isolation vs. Frequency



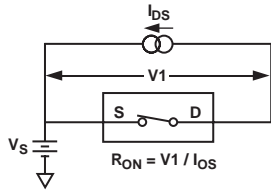
TPC 11. Logic Threshold vs. Supply Voltage



TPC 9. Crosstalk vs. Frequency

# ADG819/ADG820

## Test Circuits



Test Circuit 1. ON Resistance



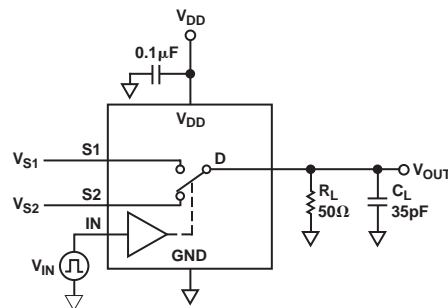
Test Circuit 2. OFF Leakage



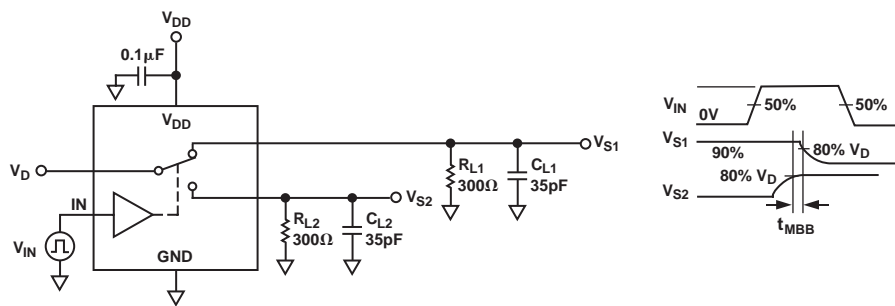
Test Circuit 3. ON Leakage



Test Circuit 4. Switching Times

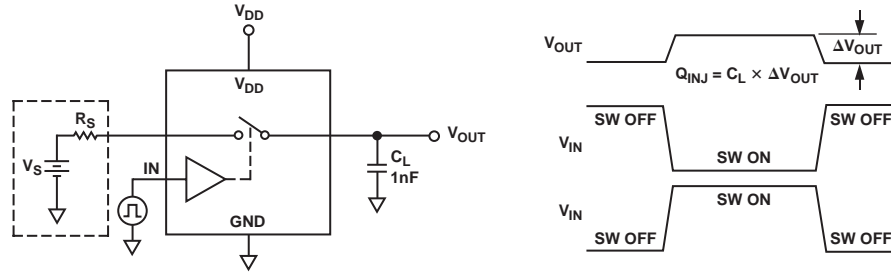


Test Circuit 5. Break-Before-Make Time Delay,  $t_{BBM}$  (ADG819 Only)

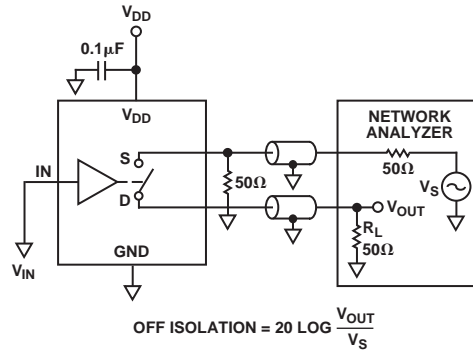


Test Circuit 6. Make-Before-Break Time Delay,  $t_{MBB}$  (ADG820 Only)

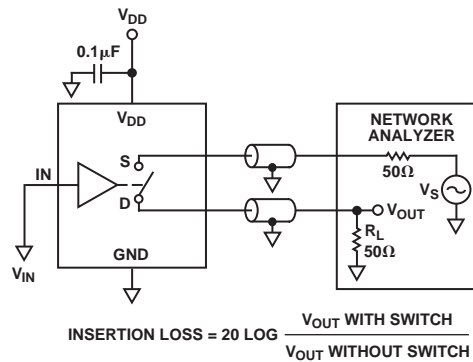




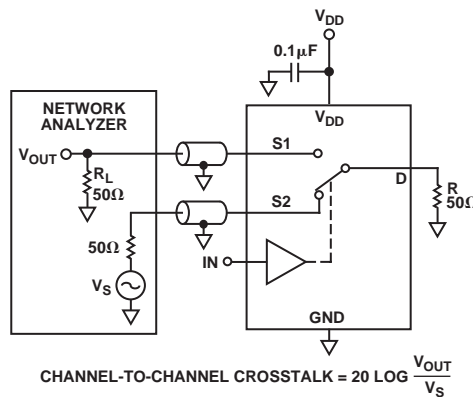
Test Circuit 7. Charge Injection



Test Circuit 8. OFF Isolation



Test Circuit 9. Bandwidth

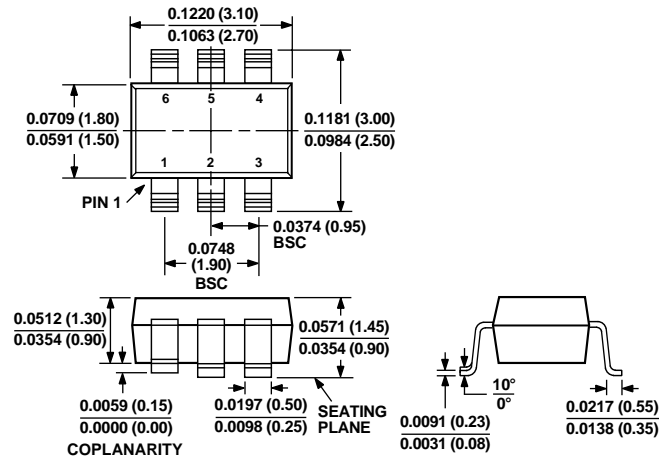


Test Circuit 10. Channel-to-Channel Crosstalk

## OUTLINE DIMENSIONS

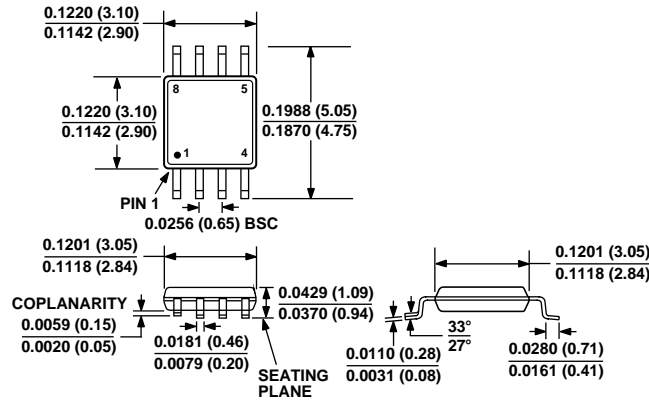
### 6-Lead Plastic Surface-Mount Package (RJ-6)

Dimensions shown in inches and (mm)



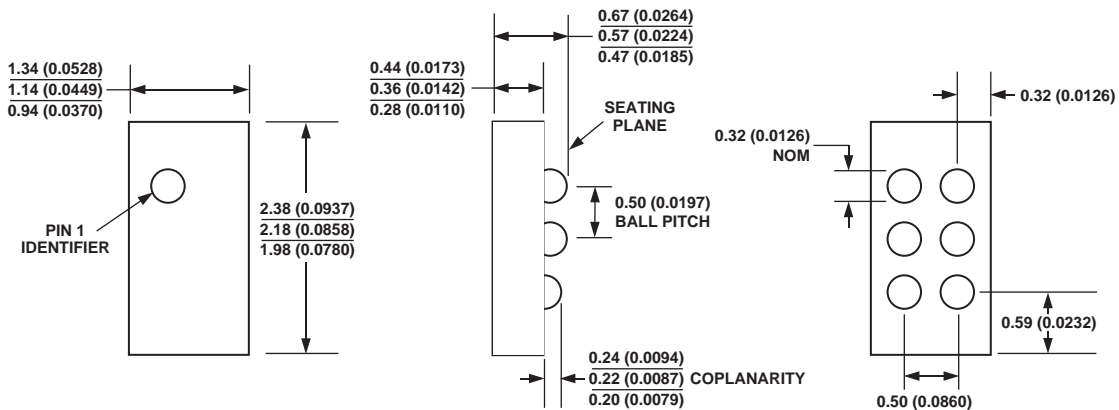
### 8-Lead $\mu$ SOIC Package (RM-8)

Dimensions shown in inches and (mm)



### 2 × 3 Array for MicroCSP (CB-6)

Dimensions shown in millimeters and (inches)



CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN





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- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
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- Формирование склада под заказчика.
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- Входной контроль качества.
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- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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