3 V/5 V CMOS <1 Ω SPDT Switch

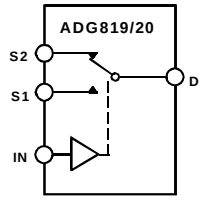
Preliminary Technical Data

ADG819/820

FEATURES
Low On Resistnace <0.8 Ω max at 5 V supply
0.2 Ω max On-Resistance Flatness
+1.8 V to +5.5 V Single Supply
High Current Carrying Capability
Extended Temperature Range: +125°
Rail-to-Rail Operation
6-Lead SOT-23 Package, 8-Lead µSOIC Package,
Wafer-Level Chipscale Package
Fast Switching Times
Typical Power Consumption (<0.01 µW)
TTL/CMOS Compatible Inputs
Pin Compatible with the ADG719 (ADG819)

APPLICATIONS
Power Routing
Battery Powered Systems
Communication Systems
Data Acquisition Systems
Audio and Video Signal Routing
Cellular Phones
Modems
PCMCIA Cards
Hard Drives
Audio and Video Switching
Relay Replacement

FUNCTIONAL BLOCK DIAGRAM



SWITCHES SHOWN FOR A LOGIC "1" INPUT

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 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 ADG819/820 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 ADG819/820 are available in a 6-lead SOT-23 package and an 8-lead µSOIC package. The ADG819 is also available in a 2x3 array Wafer-level Chipscale package. This chip occupies only a 2.18mm x 1.14mm area, thus making it the ideal candidate for space-constrained applications.

PRODUCT HIGHLIGHTS

1. Very Low On Resistance, 0.5 Ω typical.
2. +1.8 V to +5.5 V Single Supply Operation.
3. Low Power Dissipation. CMOS construction ensures low power dissipation.
4. High Current Carrying Capability.
5. Tiny 6-Lead SOT-23 Package, 8-Lead µSOIC Package and 2x3 array Wafer-level Chipscale Package.

REV. PrF 01/02

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ADG819/820–SPECIFICATIONS[1]

(V_{DD} = +5 V ± 10%, GND = 0 V. All specifications -40°C to +125°C unless otherwise noted.)

Parameter	+25°C	–40°C to +85°C	–40°C to +125°C	Units	Test Conditions/Comments
ANALOG SWITCH					
Analog Signal Range			0 V to V_{DD}	V	
On Resistance (R_{ON})	0.5			Ω typ	V_S = 0 V to V_{DD}, I_S = –10 mA
	0.8		1	Ω max	Test Circuit 1
On Resistance Match Between Channels (ΔR_{ON})	0.06	0.1		Ω typ	V_S = 0 V to V_{DD}, I_S = –10 mA
	0.12	0.15	0.2	Ω max	
On-Resistance Flatness ($R_{FLAT(ON)}$)	0.1			Ω typ	V_S = 0 V to V_{DD}, I_S = –10 mA
		0.2	0.25	Ω max	
LEAKAGE CURRENTS					V_{DD} = +5.5 V
Source OFF Leakage I_S (OFF)	±0.01			nA typ	V_S = 4.5 V/1 V, V_D = 1 V/4.5 V
	±0.5	±1	TBD	nA max	Test Circuit 2
Channel ON Leakage I_D, I_S (ON)	±0.01			nA typ	V_S = V_D = 1 V, or V_S = V_D = 4.5 V
	±0.5	±1	TBD	nA max	Test Circuit 3
DIGITAL INPUTS					
Input High Voltage, V_{INH}			2.4	V min	
Input Low Voltage, V_{INL}			0.8	V max	
Input Current					
I_{INL} or I_{INH}	0.005			µA typ	V_{IN} = V_{INL} or V_{INH}
			±0.1	µA max	
DYNAMIC CHARACTERISTICS[2]					
t_{ON}	30			ns typ	R_L = 50 Ω, C_L = 35 pF
	TBD		TBD	ns max	V_S = 3 V, Test Circuit 4
t_{OFF}	20			ns typ	R_L = 50 Ω, C_L = 35 pF
	TBD		TBD	ns max	V_S = 3 V, Test Circuit 4
ADG819					
Break-Before-Make Time Delay, t_{BBM}	10			ns typ	R_L = 50 Ω, C_L = 35 pF,
			TBD	ns min	V_{S1} = V_{S2} = 3 V, Test Circuit 5
ADG820					
Make-Before-Break Time Delay, t_{MBB}	15			ns typ	R_L = 50 Ω, C_L = 35 pF,
			TBD	ns min	V_S = 0 V, Test Circuit 6
Charge Injection	±20			pC typ	V_S = 0 V, R_S = 0 Ω, C_L = 1 nF' Test Circuit 7
Off Isolation	–65			dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz, Test Circuit 8
Channel-to-Channel Crosstalk	–65			dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz, Test Circuit 10
Bandwidth –3 dB	30			MHz typ	R_L = 50 Ω, C_L = 5 pF, Test Circuit 9
C_S (OFF)	25			pF typ	
$C_{D,}$ C_S (ON)	75			pF typ	
POWER REQUIREMENTS					V_{DD} = +5.5 V Digital Inputs = 0 V or 5.5 V
I_{DD}	0.001			µA typ	
			1.0	µA max	

NOTES

[1]Temperature ranges are as follows: Extended Range: –40°C to +125°C.

[2]Guaranteed by design, not subject to production test.

Specifications subject to change without notice.

ADG819/820–SPECIFICATIONS[1] (V_{DD} = +2.7 V to +3.6 V, GND = 0 V. All specifications -40°C to +125°C unless otherwise noted.)

Parameter	+25°C	–40°C to +85°C	-40°C to +125°C	Units	Test Conditions/Comments
ANALOG SWITCH					
Analog Signal Range			0 V to V_{DD}	V	
On Resistance (R_{ON})	1			Ω typ	V_S = 0 V to V_{DD}, I_S = –10 mA,
	1.6		2	Ω max	Test Circuit 1
On Resistance Match Between Channels (ΔR_{ON})	0.1			Ω typ	V_S = 0 V to V_{DD}, I_S = –10 mA
On-Resistance Flatness ($R_{FLAT(ON)}$)	0.2		TBD	Ω typ	V_S = 0 V to V_{DD}, I_S = –10 mA
LEAKAGE CURRENTS					V_{DD} = +3.3 V
Source OFF Leakage I_S (OFF)	±0.01			nA typ	V_S = 3 V/1 V, V_D = 1 V/3 V,
	±0.5	±1	TBD	nA max	Test Circuit 2
Channel ON Leakage I_D, I_S (ON)	±0.01			nA typ	V_S = V_D = 1 V, or V_S = V_D = 3 V,
	±0.5	±1	TBD	nA max	Test Circuit 3
DIGITAL INPUTS					
Input High Voltage, V_{INH}			2.0	V min	
Input Low Voltage, V_{INL}			0.4	V max	
Input Current					
I_{INL} or I_{INH}	0.005			µA typ	V_{IN} = V_{INL} or V_{INH}
			±0.1	µA max	
DYNAMIC CHARACTERISTICS[2]					
t_{ON}	50			ns typ	R_L = 50 Ω, C_L = 35 pF
	TBD		TBD	ns max	V_S = 1.5 V, Test Circuit 4
t_{OFF}	40			ns typ	R_L = 50 Ω, C_L = 35 pF
	TBD		TBD	ns max	V_S = 1.5 V, Test Circuit 4
ADG819					
Break-Before-Make Time Delay, t_{BBM}	10			ns typ	R_L = 50 Ω, C_L = 35 pF,
			TBD	ns min	V_{S1} = V_{S2} = 1.5 V, Test Circuit 5
ADG820					
Make-Before-Break Time Delay, t_{MBB}	15			ns typ	R_L = 50 Ω, C_L = 35 pF,
			TBD	ns min	V_S = 1.5 V, Test Circuit 6
Charge Injection	±20			pC typ	V_S = 0 V, R_S = 0 Ω, C_L = 1 nF, Test Circuit 7
Off Isolation	–65			dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz, Test Circuit 8
Channel-to-Channel Crosstalk	–65			dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz, Test Circuit 10
Bandwidth –3 dB	30			MHz typ	R_L = 50 Ω, C_L = 5 pF, Test Circuit 9
C_S (OFF)	25			pF typ	
C_D, C_S (ON)	75			pF typ	
POWER REQUIREMENTS					V_{DD} = +3.3 V Digital Inputs = 0 V or 3.3 V
I_{DD}	0.001			µA typ	
			1.0	µA max	

NOTES

[1]Temperature ranges are as follows: Extended Range: –40°C to +125°C.

[2]Guaranteed by design, not subject to production test.

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS[1]

(T_A = +25°C unless otherwise noted)

V_{DD} to GND ..... –0.3 V to +7 V
Analog Inputs[2] ..... -0.3 V to V_{DD} + 0.3 V or 30 mA, Whichever Occurs First
Digital Inputs[2] ..... –0.3 V to V_{DD} + 0.3 V or 30 mA, Whichever Occurs First
Peak Current, S or D ..... 400 mA (Pulsed at 1 ms, 10% Duty Cycle max)
Continuous Current, S or D ..... 200 mA
Operating Temperature Range
  Extended ..... –40°C to +125°C
Storage Temperature Range ..... –65°C to +150°C
Junction Temperature ..... +150°C
µSOIC Package
  θ_{JA} Thermal Impedance ..... 206°C/W
  θ_{JC} Thermal Impedance ..... 44°C/W
SOT-23 Package
  θ_{JA} Thermal Impedance ..... 229.6°C/W
  θ_{JC} Thermal Impedance ..... 91.99°C/W
WLCSP Package
  θ_{JA} Thermal Impedance ..... °C/W
  θ_{JC} Thermal Impedance ..... °C/W
Lead Temperature, Soldering (10 seconds) ..... 300°C
  IR Reflow, Peak Temperature ..... +220°C

NOTES
[1]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.
[2]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

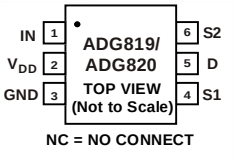
ORDERING GUIDE

Model Option	Temperature Range	Supply Option	Brand[1]	Package Description	Package
ADG819BRM	–40°C to +125°C	3 V, 5 V	SNB	µSOIC (microSmall Outline IC)	RM-8
ADG819BRT	–40°C to +125°C	3 V, 5 V	SNB	SOT-23 (Plastic Surface Mount)	RT-6
ADG819BCB	–40°C to +85°C	3 V, 5 V	SNB	WLCSP (Wafer-Level Chip Scale Package)	CB-6*
ADG820BRM	–40°C to +125°C	3 V, 5 V	SPB	µSOIC (microSmall Outline IC)	RM-8
ADG820BRT	–40°C to +125°C	3 V, 5 V	SPB	SOT-23 (Plastic Surface Mount)	RT-6

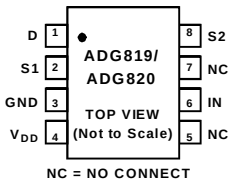
[1]Branding on all packages is limited to three characters due to space constraints.
*Contact factory for availability

PIN CONFIGURATIONS

6-Lead SOT-23 (RT-6)

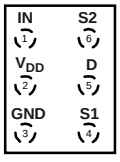


8-Lead µSOIC (RM-8)



2x3 WLCSP

TOP VIEW (bumps at the bottom). Not to Scale



ADG819 Only

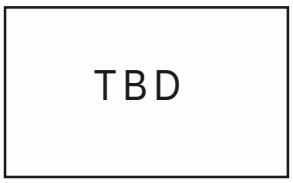
TERMINOLOGY

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.
ΔR_{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 transfered from the Digital input to the Analog output during switching.
Crosstalk	A measure of unwanted signal that is coupled through from one channel to another as a result of parasitic capacitance.
Off Isolation	A measure of unwanted signal coupling through an "OFF" switch.
Bandwidth	The frequency at which the output is attenuated by –3 dBs.
On Response	The frequency reponse of the "ON" switch.
Insertion Loss	The Loss due to the ON resistance of the Switch.

CAUTION

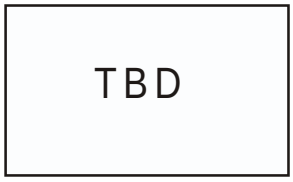
ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the ADG819/820 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

Typical Performance Characteristics



TPC 1.

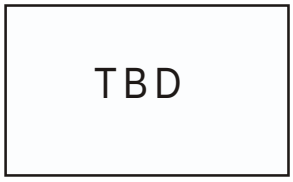
TPC 2.



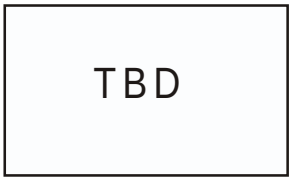
TPC 3.

TPC 4.

TPC 5.

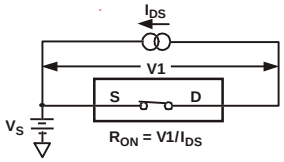


TPC 6.

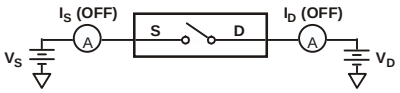


TPC 7.

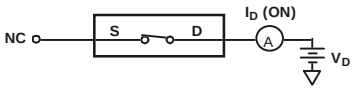
Test Circuits



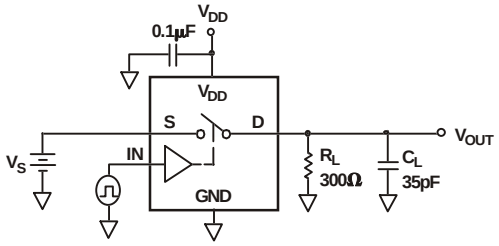
Test Circuit 1. On Resistance

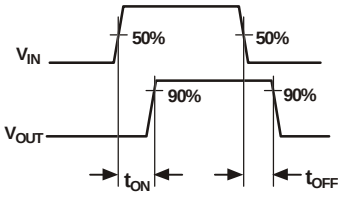


Test Circuit 2. Off Leakage

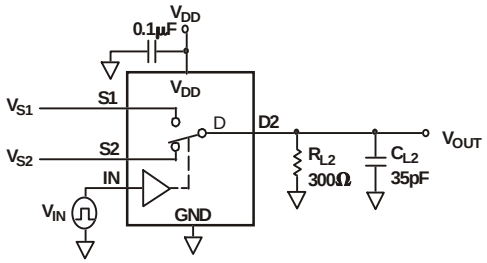


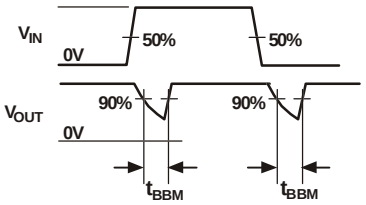
Test Circuit 3. On Leakage



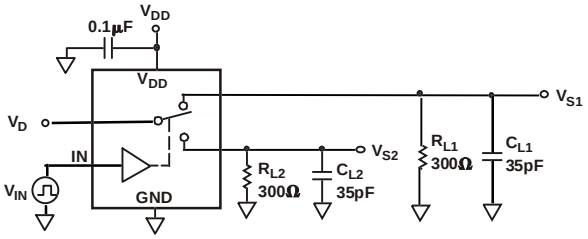


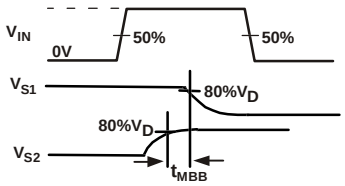
Test Circuit 4. Switching TImes



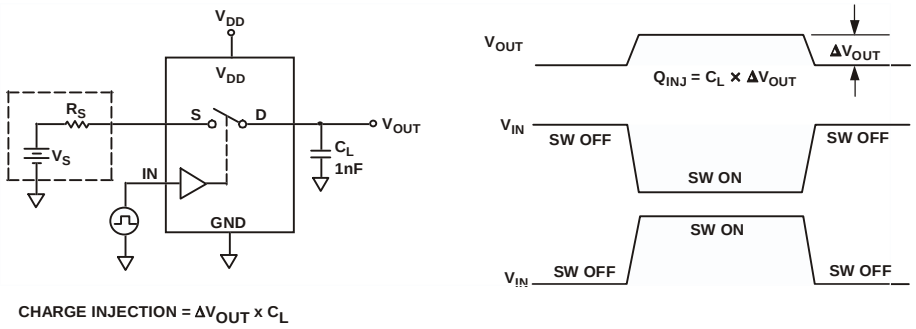


Test Circuit 5. Break-Before-Make Time Delay, t_{BBM} (ADG819 only)

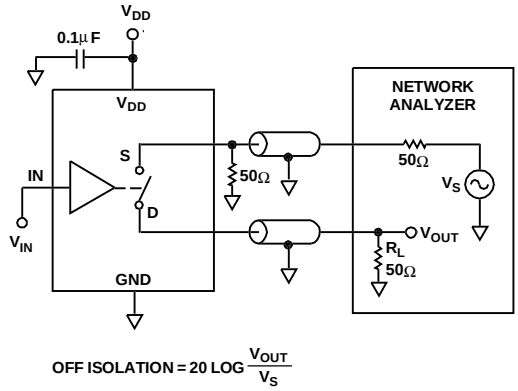




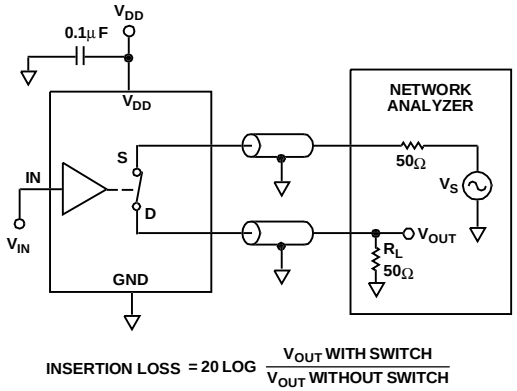
Test Circuit 6. Make-Before-Break Time Delay, t_{MBB} (ADG820 only)



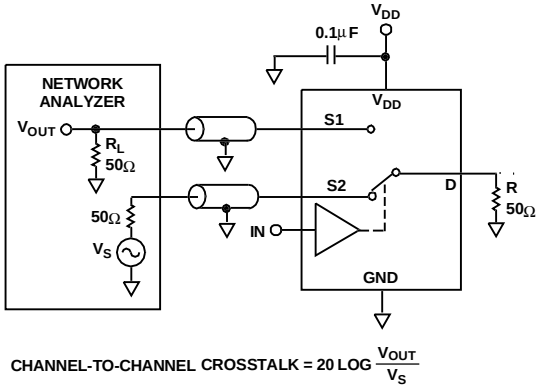
Test Circuit 7. Charge Injection



Test Circuit 8. Off Isolation



Test Circuit 9. Bandwidth

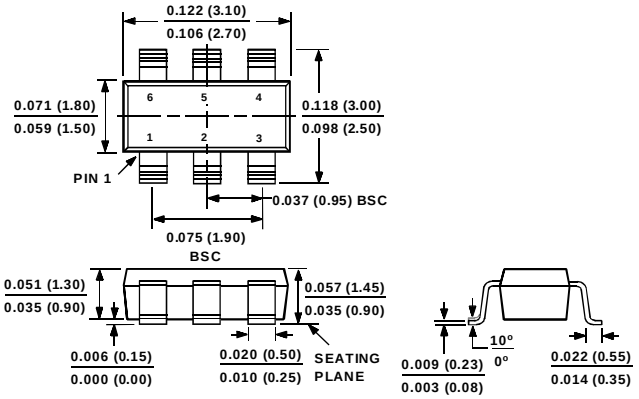


Test Circuit 10. Channel-to-Channel Crosstalk

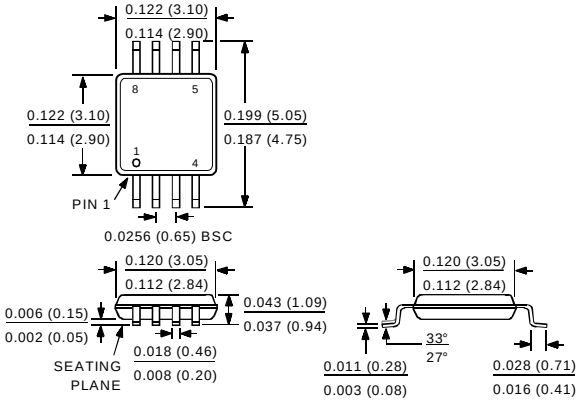
OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

6-Lead Plastic Surface Mount Package (RT-6)



8-Lead µSOIC Package (RM-8)



2x3 Array for WLCSP (CB-6)