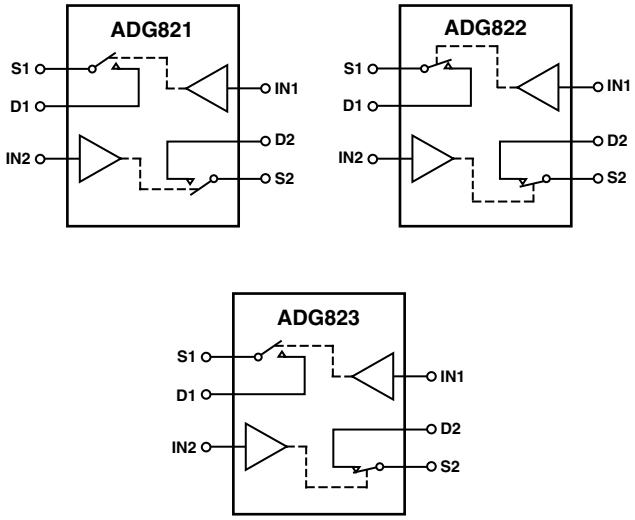
<1 Ω CMOS 1.8 V to 5.5 V, Dual SPST Switches

ADG821/ADG822/ADG823

FEATURES
0.8 Ω Max On Resistance @125°C
0.28 Ω Max On Resistance Flatness @125°C
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
8-Lead MSOP Package
33 ns Switching Times
Typical Power Consumption (<0.01 μW)
TTL/CMOS Compatible Inputs
Pin Compatible with ADG721/722/723

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

FUNCTIONAL BLOCK DIAGRAM



SWITCHES SHOWN FOR A LOGIC "0" INPUT

GENERAL DESCRIPTION

The ADG821, ADG822, and ADG823 are monolithic CMOS SPST (single pole, single throw) switches. These switches are designed on an advanced submicron process that provides low power dissipation, yet gives high switching speed, low on resistance, and low leakage currents.

The ADG821, ADG822, and ADG823 are designed to operate from a single 1.8 V to 5.5 V supply, making them ideal for use in battery-powered instruments.

Each switch of the ADG821/ADG822/ADG823 conducts equally well in both directions when on. The ADG821, ADG822, and ADG823 contain two independent SPST switches. The ADG821 and ADG822 differ only in that both switches are normally open and normally closed, respectively. In the ADG823, Switch 1 is normally open and Switch 2 is normally closed. The ADG823 exhibits break-before-make switching action.

The ADG821, ADG822, and ADG823 are available in an 8-lead MSOP package.

PRODUCT HIGHLIGHTS

1. Very Low On Resistance (0.5 Ω typ)
2. On Resistance Flatness ($R_{FLAT(ON)}$) (0.15 Ω typ)
3. Automotive Temperature Range –40°C to +125°C
4. 200 mA Current Carrying Capability
5. Low Power Dissipation. CMOS construction ensures low power dissipation.
6. 8-Lead MSOP Package

REV. 0

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781/329-4700 **www.analog.com**
Fax: 781/326-8703

ADG821/ADG822/ADG823–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[2]	Unit	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 = 100 mA;
	0.6	0.7	0.8	Ω max	Test Circuit 1
On Resistance Match Between Channels (ΔR_{ON})	0.16			Ω typ	V_S = 0 V to V_{DD}, I_S = 100 mA
	0.2	0.25	0.28	Ω max	
On Resistance Flatness ($R_{FLAT(ON)}$)	0.15			Ω typ	V_S = 0 V to V_{DD}, I_S = 100 mA
	0.23	0.26	0.3	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;
	±0.25	±3	±25	nA max	Test Circuit 2
Drain OFF Leakage I_D (OFF)	±0.01			nA typ	V_S = 4.5 V/1 V, V_D = 1 V/4.5 V;
	±0.25	±3	±25	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;
	±0.25	±3	±25	nA max	Test Circuit 3
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}	0.005			µA typ	V_{IN} = V_{INL} or V_{INH}
			±0.1	µA max	
C_{IN}, Digital Input Capacitance	4			pF typ	
DYNAMIC CHARACTERISTICS[3]					
t_{ON}	33			ns typ	R_L = 50 Ω, C_L = 35 pF,
	45	48	52	ns max	V_S = 3 V; Test Circuit 4
t_{OFF}	11			ns typ	R_L = 50 Ω, C_L = 35 pF,
	16	19	21	ns max	V_S = 3 V; Test Circuit 4
Break-Before-Make Time Delay, t_{BBM}	32			ns typ	R_L = 50 Ω, C_L = 35 pF,
(ADG823 Only)			1	ns min	V_{S1} = V_{S2} = 3 V; Test Circuit 5
Charge Injection	15			pC typ	V_S = 2.5 V; R_S = 0 Ω, C_L = 1 nF; Test Circuit 6
Off Isolation	–52			dB typ	R_L = 50 Ω, C_L = 5 pF, f =1 MHz; Test Circuit 7
Channel-to-Channel Crosstalk	–82			dB typ	R_L = 50 Ω, C_L = 5 pF f = 1 MHz; Test Circuit 9
Bandwidth –3 dB	24			MHz typ	R_L = 50 Ω, C_L = 5 pF; Test Circuit 8
C_S (OFF)	85			pF typ	f =1 MHz
C_D (OFF)	98			pF typ	f =1 MHz
C_D, C_S (ON)	230			pF typ	f =1 MHz
POWER REQUIREMENTS					V_{DD} = 5.5 V Digital Inputs = 0 V or 5.5 V
I_{DD}	0.001			µA typ	
		1.0	2.0	µA max	

NOTES
[1]Temperature range: Automotive range: –40°C to +125°C.
[2]On resistance parameters tested with I_S = 10 mA.
[3]Guaranteed by design, not subject to production test.
Specifications subject to change without notice.

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

Parameter	25°C	–40°C to +85°C	–40°C to +125°C[2]	Unit	Test Conditions/Comments
ANALOG SWITCH					
Analog Signal Range			0 V to V_{DD}	V	
On Resistance (R_{ON})	0.7			Ω typ	V_S = 0 V to V_{DD}, I_S = 100 mA;
	1.4	1.5	1.6	Ω max	Test Circuit 1
On Resistance Match Between	0.16			Ω typ	
Channels (ΔR_{ON})	0.2	0.25	0.28	Ω max	V_S = 0 V to V_{DD}, I_S = 100 mA
On Resistance Flatness ($R_{FLAT(ON)}$)	0.3		0.33	Ω typ	V_S = 0 V to V_{DD}, I_S = 100 mA
LEAKAGE CURRENTS					V_{DD} = 3.6 V
Source OFF Leakage I_S (OFF)	±0.01			nA typ	V_S = 3.3 V/1 V, V_D = 1 V/3.3 V;
	±0.25	±3	±15	nA max	Test Circuit 2
Drain OFF Leakage I_D (OFF)	±0.01			nA typ	V_S = 3.3 V/1 V, V_D = 1 V/3.3 V;
	±0.25	±3	±25	nA max	Test Circuit 2
Channel ON Leakage I_D, I_S (ON)	±0.01			nA typ	V_S = V_D = 1 V, or 3.3 V;
	±0.25	±3	±25	nA max	Test Circuit 3
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}	0.005			µA typ	V_{IN} = V_{INL} or V_{INH}
			±0.1	µA max	
C_{IN}, Digital Input Capacitance	4			pF typ	
DYNAMIC CHARACTERISTICS[3]					
t_{ON}	48			ns typ	R_L = 50 Ω, C_L = 35 pF,
	67	74	78	ns max	V_S = 1.5 V; Test Circuit 4
t_{OFF}	12			ns typ	R_L = 50 Ω, C_L = 35 pF,
	18	20	23	ns max	V_S = 1.5 V; Test Circuit 4
Break-Before-Make Time Delay, t_{BBM}	40			ns typ	R_L = 50 Ω, C_L = 35 pF,
(ADG823 Only)			1	ns min	V_{S1} = V_{S2} = 1.5V; Test Circuit 5
Charge Injection	±2			pC typ	V_S =1.5 V; R_S = 0 Ω, C_L = 1 nF; Test Circuit 6
Off Isolation	–52			dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz; Test Circuit 7
Channel-to-Channel Crosstalk	–82			dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz; Test Circuit 9
Bandwidth –3 dB	24			MHz typ	R_L = 50 Ω, C_L = 5 pF; Test Circuit 8
C_S (OFF)	85			pF typ	f =1 MHz
C_D (OFF)	98			pF typ	f =1 MHz
C_D, C_S (ON)	230			pF typ	f =1 MHz
POWER REQUIREMENTS					V_{DD} = 3.6 V Digital Inputs = 0 V or 3.6 V
I_{DD}	0.001			µA typ	
		1.0	2.0	µA max	

NOTES
[1]Temperature range: Automotive range: –40°C to +125°C.
[2]On resistance parameters tested with I_S = 10 mA.
[3]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
  Automotive ..... –40°C to +125°C
Storage Temperature Range ..... –65°C to +150°C
Junction Temperature (T_j max) ..... 150°C
Package Power Dissipation ..... (T_j max – T_A)/θ_{JA}
8-Lead MSOP Package
  θ_{JA} Thermal Impedance ..... 206°C/W
  θ_{JC} Thermal Impedance ..... 44°C/W
Lead Temperature, Soldering (10 sec) ..... 300°C
IR Reflow, Peak Temperature (<20 sec) ..... 235°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 ADG821/ADG822

ADG821 INx	ADG822 INx	Switch x Condition
0	1	OFF
1	0	ON

Table II. Truth Table for the ADG823

IN1	IN2	Switch S1	Switch S2
0	0	OFF	ON
0	1	OFF	OFF
1	0	ON	ON
1	1	ON	OFF

ORDERING GUIDE

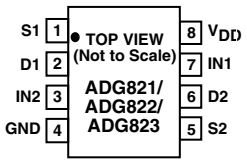
Model Option	Temperature Range	Brand*	Package Description	Package
ADG821BRM	–40°C to +125°C	SQB	MSOP (microSmall Outline IC)	RM-8
ADG822BRM	–40°C to +125°C	SRB	MSOP (microSmall Outline IC)	RM-8
ADG823BRM	–40°C to +125°C	SSB	MSOP (microSmall Outline IC)	RM-8

*Branding on MSOP packages is limited to three characters due to space constraints.

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 ADG821/ADG822/ADG823 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.

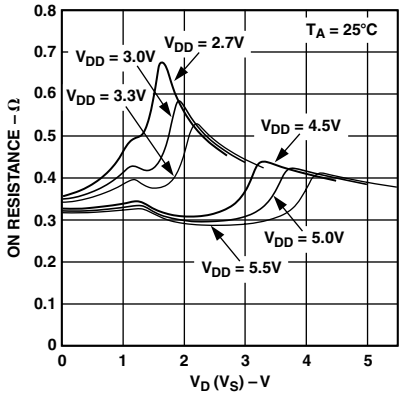
PIN CONFIGURATION
8-Lead MSOP
(RM-8)



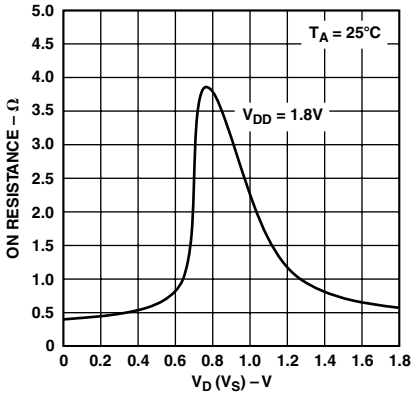
TERMINOLOGY

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 (OFF)	Drain 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 and 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 (OFF)	OFF Switch Drain 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.
Charge Injection	It is a measure of the glitch impulse transferred from the digital input to the analog output during switching.
Crosstalk	It is 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 Response of the ON Switch
Insertion Loss	The Loss due to the On Resistance of the Switch

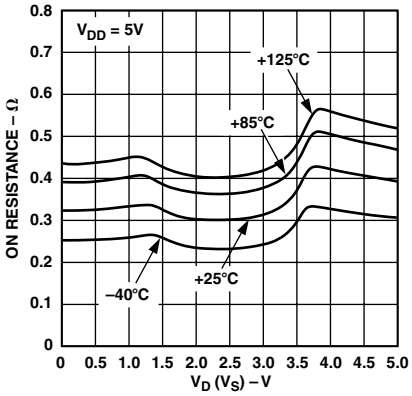
ADG821/ADG822/ADG823–Typical Performance Characteristics



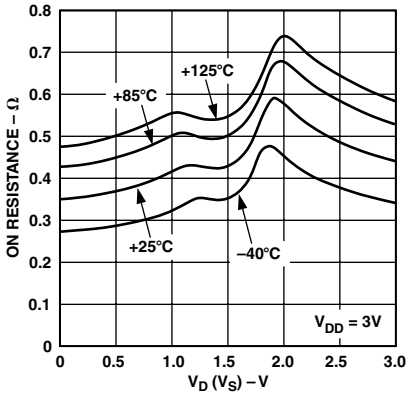
TPC 1. On Resistance vs. V_D (V_S)



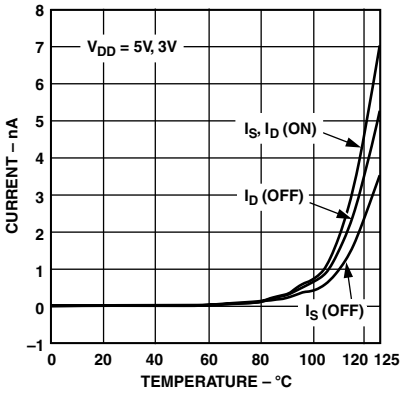
TPC 2. On Resistance vs. V_D (V_S)



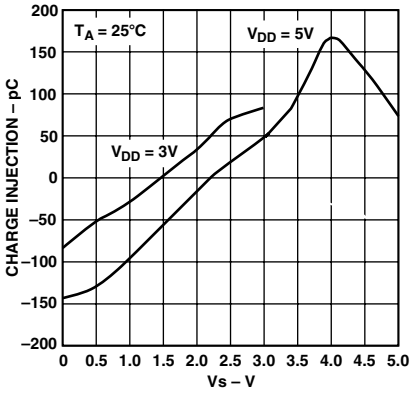
TPC 3. On Resistance vs. V_D (V_S) for Different Temperatures



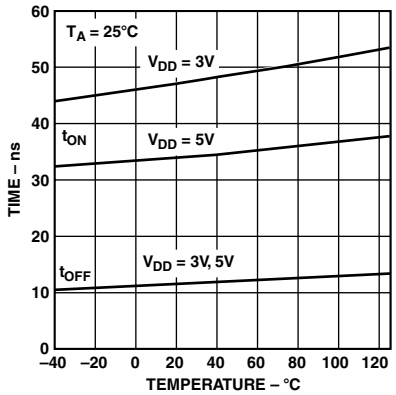
TPC 4. On Resistance vs. V_D (V_S) for Different Temperatures



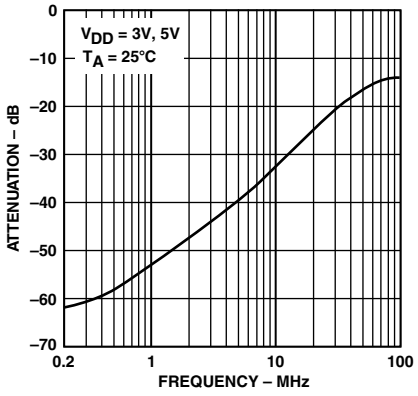
TPC 5. Leakage Currents vs. Temperature



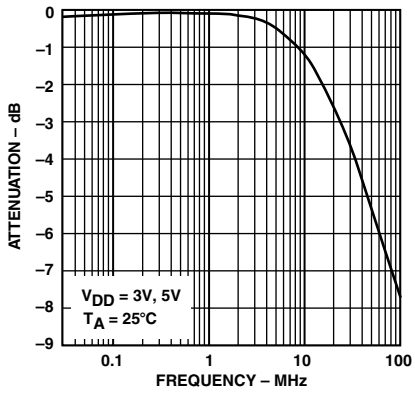
TPC 6. Charge Injection vs. Source Voltage



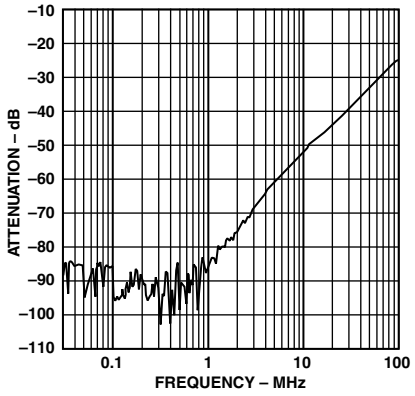
TPC 7. t_{ON}/t_{OFF} vs. Temperature



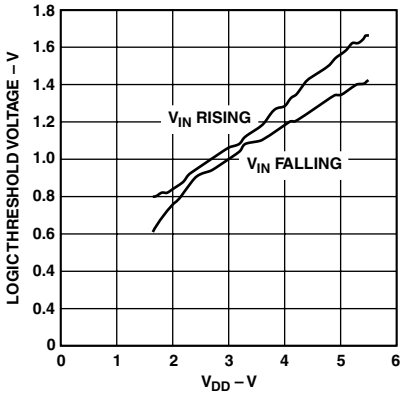
TPC 8. Off Isolation vs. Frequency



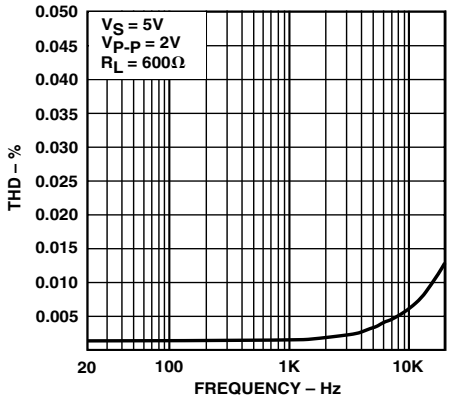
TPC 9. On Response vs. Frequency



TPC 10. Crosstalk vs. Frequency

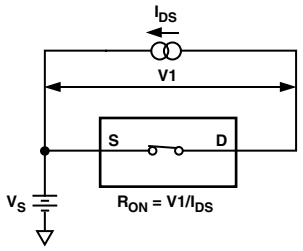


TPC 11. Logic Threshold Voltage vs. Suppply Voltage

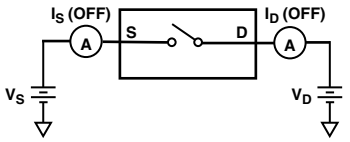


TPC 12. THD

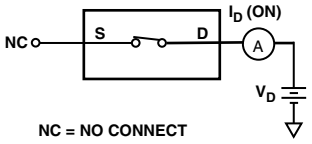
Test Circuits



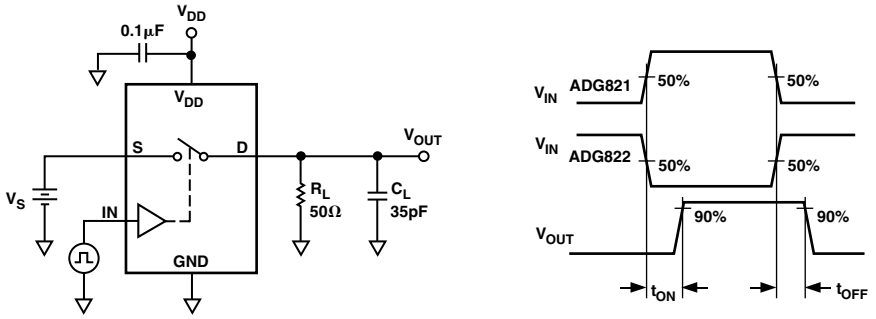
Test Circuit 1. On Resistance



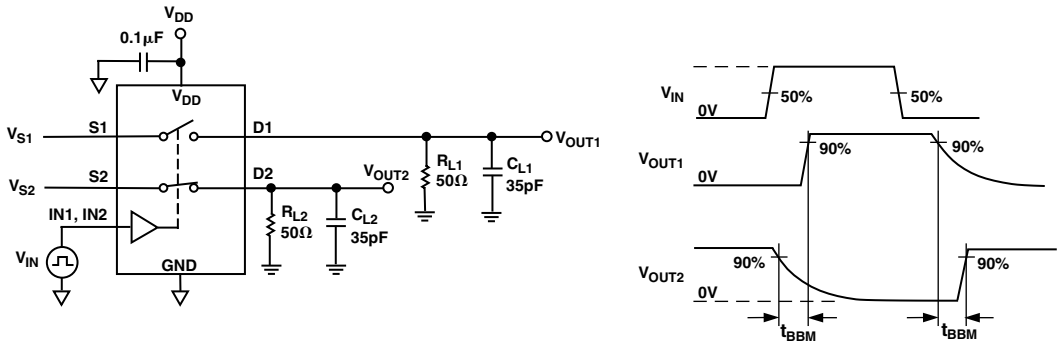
Test Circuit 2. Off Leakage



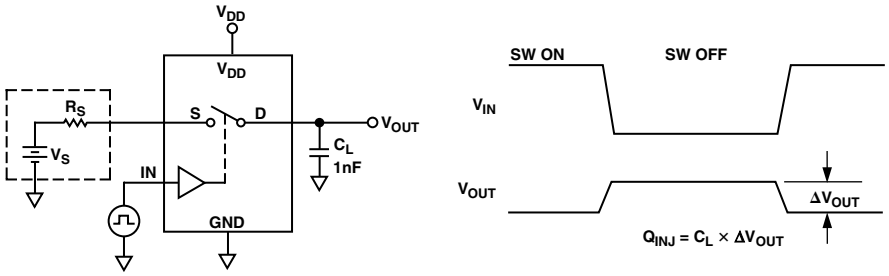
Test Circuit 3. On Leakage



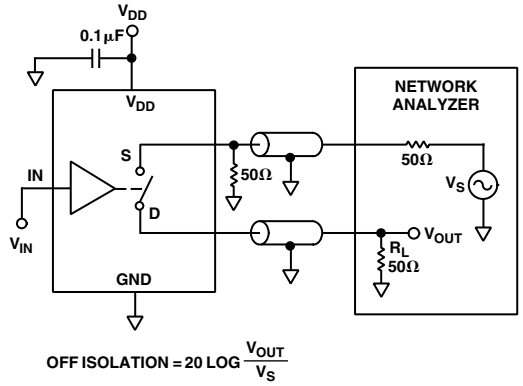
Test Circuit 4. Switching Times



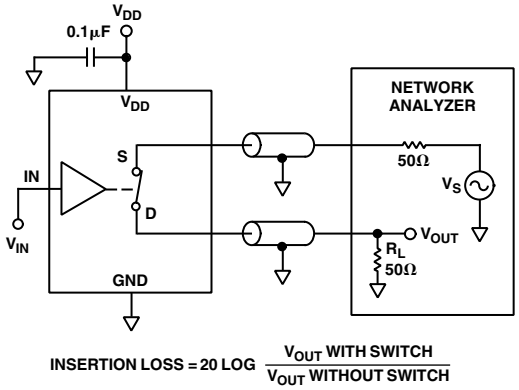
Test Circuit 5. Break-Before-Make Time Delay, t_{BBM} (ADG823 only)



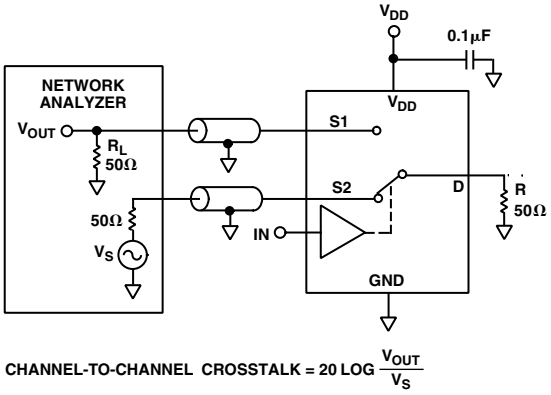
Test Circuit 6. Charge Injection



Test Circuit 7. Off Isolation



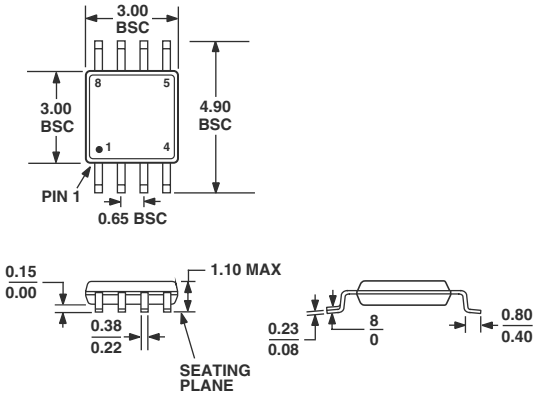
Test Circuit 8. Bandwidth



Test Circuit 9. Channel-to-Channel Crosstalk

OUTLINE DIMENSIONS

8-Lead MSOP Package [MSOP]
(RM-8)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-187AA

C02851–0–8/02(0)

PRINTED IN U.S.A.