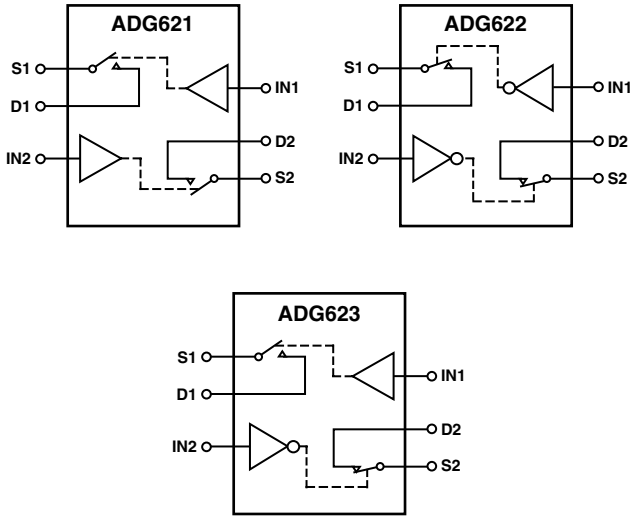
CMOS ±5 V/5 V 4 Ω Dual SPST Switches

ADG621/ADG622/ADG623

FEATURES
5.5 Ω (Max) On Resistance
0.9 Ω (Max) On-Resistance Flatness
2.7 V to 5.5 V Single Supply
±2.7 V to ±5.5 V Dual Supply
Rail-to-Rail Operation
10-Lead μSOIC Package
Typical Power Consumption (<0.01 μW)
TTL/CMOS Compatible Inputs

APPLICATIONS
Automatic Test Equipment
Power Routing
Communication Systems
Data Acquisition Systems
Sample and Hold Systems
Avionics
Relay Replacement
Battery-Powered Systems

FUNCTIONAL BLOCK DIAGRAM



SWITCHES SHOWN FOR A LOGIC "0" INPUT

GENERAL DESCRIPTION

The ADG621, ADG622, and the ADG623 are monolithic, CMOS SPST (single-pole, single-throw) switches. Each switch of the ADG621, ADG622, and ADG623 conducts equally well in both directions when on.

The ADG621/ADG622/ADG623 contain two independent switches. The ADG621 and ADG622 differ only in that both switches are normally open and normally closed respectively. In the ADG623, Switch 1 is normally open and Switch 2 is normally closed. The ADG623 exhibits break-before-make switching action.

The ADG621/ADG622/ADG623 offers low on-resistance of 4 Ω, which is matched to within 0.25 Ω between channels. These switches also provide low power dissipation yet gives high switching speeds. The ADG621, ADG622, and ADG623 are available in a 10-lead μSOIC package.

PRODUCT HIGHLIGHTS

1. Low On Resistance (R_{ON}) (4 Ω typ)
2. Dual ±2.7 V to ±5.5 V or Single 2.7 V to 5.5 V
3. Low Power Dissipation. CMOS construction ensures low power dissipation.
4. Tiny 10-Lead μSOIC 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

ADG621/ADG622/ADG623–SPECIFICATIONS

DUAL SUPPLY[1] (V_{DD} = +5 V ± 10%, V_{SS} = –5 V ± 10%, GND = 0 V. All specifications –40°C to +85°C unless otherwise noted.)

Parameter	B Version +25°C	B Version –40°C to +85°C	Unit	Test Conditions/Comments
ANALOG SWITCH				
Analog Signal Range		V_{SS} to V_{DD}	V	V_{DD} = +4.5 V, V_{SS} = –4.5 V
On Resistance (R_{ON})	4		Ω typ	V_S = ±4.5 V, I_S = –10 mA,
	5.5	7	Ω max	Test Circuit 1
On Resistance Match Between Channels (ΔR_{ON})	0.25		Ω typ	V_S = ±4.5 V, I_S = –10 mA
	0.35	0.4	Ω max	
On-Resistance Flatness ($R_{FLAT(ON)}$)	0.9	0.9	Ω typ	V_S = ±3.3 V, I_S = –10 mA
		1.5	Ω max	
LEAKAGE CURRENTS				V_{DD} = +5.5 V, V_{SS} = –5.5 V
Source OFF Leakage I_S (OFF)	±0.01		nA typ	V_S = ±4.5 V, V_D = ∓4.5 V,
	±0.25	±1	nA max	Test Circuit 2
Drain OFF Leakage I_D (OFF)	±0.01		nA typ	V_S = ±4.5 V, V_D = ∓4.5 V,
	±0.25	±1	nA max	Test Circuit 2
Channel ON Leakage I_D, I_S (ON)	±0.01		nA typ	V_S = V_D = ±4.5 V, Test Circuit 3
	±0.25	±1	nA max	
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	
C_{IN}, Digital Input Capacitance	2		pF typ	
DYNAMIC CHARACTERISTICS[2]				
t_{ON}	75		ns typ	R_L = 300 Ω, C_L = 35 pF
	120	155	ns max	V_S = 3.3 V, Test Circuit 4
t_{OFF}	45		ns typ	R_L = 300 Ω, C_L = 35 pF
	70	85	ns max	V_S = 3.3 V, Test Circuit 4
Break-Before-Make Time Delay, t_{BBM}	30		ns typ	R_L = 300 Ω, C_L = 35 pF,
(ADG623 Only)		10	ns min	V_{S1} = V_{S2} = 3.3 V, Test Circuit 5
Charge Injection	110		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	–90		dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz, Test Circuit 10
Bandwidth –3 dB	230		MHz typ	R_L = 50 Ω, C_L = 5 pF, Test Circuit 9
C_S (OFF)	20		pF typ	f = 1 MHz
C_D (OFF)	20		pF typ	f = 1 MHz
C_D, C_S (ON)	70		pF typ	f = 1 MHz
POWER REQUIREMENTS				V_{DD} = +5.5 V, V_{SS} = –5.5 V
I_{DD}	0.001		µA typ	Digital Inputs = 0 V or 5.5 V
		1.0	µA max	
I_{SS}	0.001		µA typ	Digital Inputs = 0 V or 5.5 V
		1.0	µA max	

NOTES
[1]Temperature ranges are as follows: B Version, –40°C to +85°C.
[2]Guaranteed by design, not subject to production test.

Specifications subject to change without notice.

SINGLE SUPPLY[1] (V_{DD} = +5 V ± 10%, V_{SS} = 0 V, GND = 0 V. All specifications –40°C to +85°C unless otherwise noted.)

Parameter	B Version +25°C	B Version –40°C to +85°C	Unit	Test Conditions/Comments
ANALOG SWITCH				
Analog Signal Range		0 V to V_{DD}	V	
On Resistance (R_{ON})	7		Ω typ	V_{DD} = 4.5 V, V_{SS} = 0 V V_S = 0 V to 4.5 V, I_S = –10 mA,
	10	12.5	Ω max	Test Circuit 1
On Resistance Match Between Channels (ΔR_{ON})	0.5		Ω typ	V_S = 0 V to 4.5 V, I_S = –10 mA
	0.75	1	Ω max	
On-Resistance Flatness ($R_{FLAT(ON)}$)	0.5	0.5	Ω typ	V_S = 1.5 V to 3.3 V, I_S = –10 mA
		1	Ω max	
LEAKAGE CURRENTS				V_{DD} = 5.5 V
Source OFF Leakage I_S (OFF)	±0.01		nA typ	V_S = 1 V/4.5 V, V_D = 4.5 V/1 V,
	±0.25	±1	nA max	Test Circuit 2
Drain OFF Leakage I_D (OFF)	±0.01		nA typ	V_S = 1 V/4.5 V, V_D = 4.5 V/1 V,
	±0.25	±1	nA max	Test Circuit 2
Channel ON Leakage I_D, I_S (ON)	±0.01		nA typ	V_S = V_D = 1 V/4.5 V,
	±0.25	±1	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	
C_{IN}, Digital Input Capacitance	2		pF typ	
DYNAMIC CHARACTERISTICS[2]				
t_{ON}	120		ns typ	R_L = 300 Ω, C_L = 35 pF
	210	260	ns max	V_S = 3.3 V, Test Circuit 4
t_{OFF}	50		ns typ	R_L = 300 Ω, C_L = 35 pF
	75	100	ns max	V_S = 3.3 V, Test Circuit 4
Break-Before-Make Time Delay, t_{BBM} (ADG623 Only)	70		ns typ	R_L = 300 Ω, C_L = 35 pF,
		10	ns min	V_{S1} = V_{S2} = 3.3 V, Test Circuit 5
Charge Injection	6		pC typ	V_S = 0 V; R_S = 0 Ω, C_L = 1 nF, Test Circuit 6
Off Isolation	–65		dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz, Test Circuit 7
Channel-to-Channel Crosstalk	–90		dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz, Test Circuit 9
Bandwidth –3 dB	230		MHz typ	R_L = 50 Ω, C_L = 5 pF, Test Circuit 8
C_S (OFF)	20		pF typ	f = 1 MHz
C_D (OFF)	20		pF typ	f = 1 MHz
C_D, C_S (ON)	70		pF typ	f = 1 MHz
POWER REQUIREMENTS				V_{DD} = 5.5 V
I_{DD}	0.001		µA typ	Digital Inputs = 0 V or 5.5 V
		1.0	µA max	

NOTES
[1]Temperature ranges are as follows: B Version, –40°C to +85°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 V_{SS} . . . . . 13 V
V_{DD} to GND . . . . . –0.3 V to +6.5 V
V_{SS} to GND . . . . . +0.3 V to –6.5 V
Analog Inputs[2] . . . . . V_{SS} – 0.3 V to V_{DD} + 0.3 V
Digital Inputs[2] . . . . . –0.3 V to V_{DD} + 0.3 V or 30 mA, Whichever Occurs First
Peak Current, S or D . . . . . 100 mA (Pulsed at 1 ms, 10% Duty Cycle max)
Continuous Current, S or D . . . . . 50 mA
Operating Temperature Range
  Industrial (B Version) . . . . . –40°C to +85°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
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 ADG621/ADG622

ADG621 INx	ADG622 INx	Switch x Condition
0	1	OFF
1	0	ON

Table II. Truth Table for the ADG623

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	Description	Package	Branding Information*
ADG621BRM	–40°C to +85°C	μSOIC (microSmall Outline IC)	RM-10	SXB
ADG622BRM	–40°C to +85°C	μSOIC (microSmall Outline IC)	RM-10	SYB
ADG623BRM	–40°C to +85°C	μSOIC (microSmall Outline IC)	RM-10	SZB

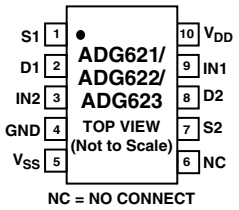
*Branding on μSOIC packages is limited to three characters due to space constraints.

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 ADG621/ADG622/ADG623 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.

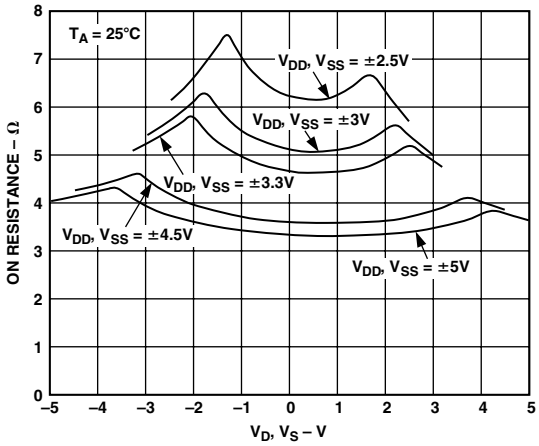
PIN CONFIGURATION

10-Lead μSOIC
(RM-10)

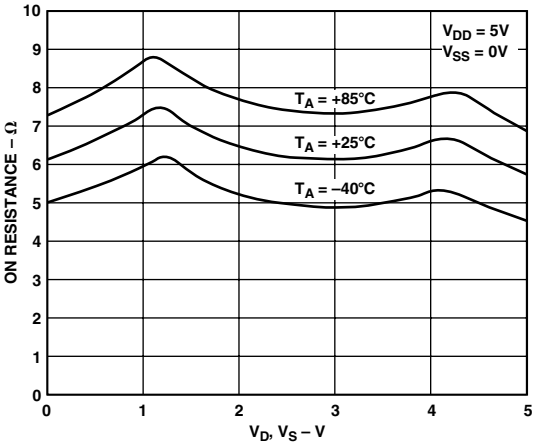


TERMINOLOGY

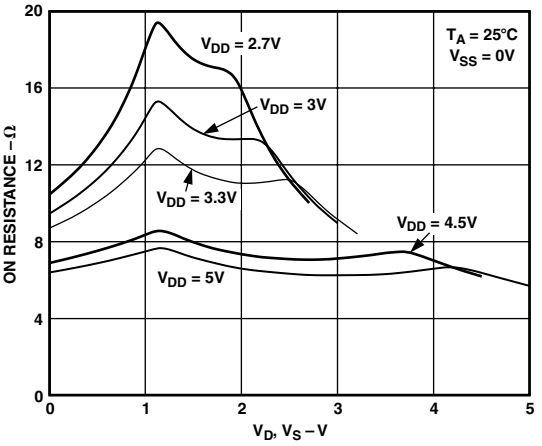
V_{DD}	Most Positive Power Supply Potential.
V_{SS}	Most Negative Power Supply in a Dual Supply Application. In single supply applications, this should be tied to ground at the device.
GND	Ground (0 V) Reference
I_{DD}	Positive Supply Current
I_{SS}	Negative Supply Current
S	Source Terminal. May be an 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, 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	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 response of the "ON" switch.
Insertion Loss	The loss due to the ON resistance of the Switch.



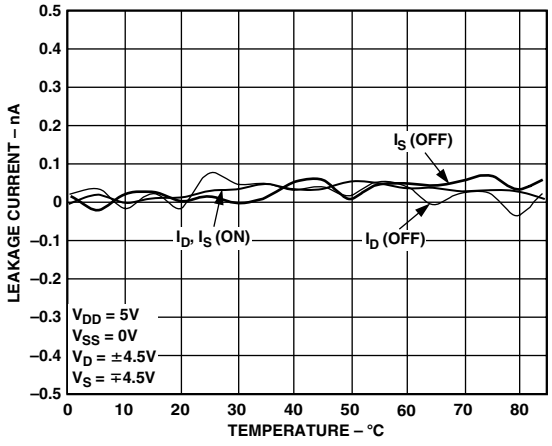
TPC 1. On Resistance vs. V_D (V_S). (Dual Supply)



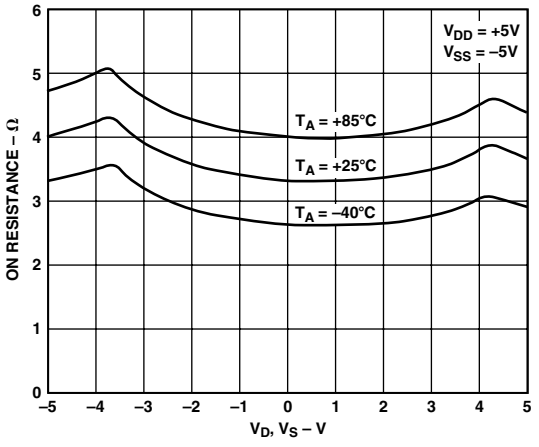
TPC 4. On Resistance vs. V_D (V_S) for Different Temperature. (Single Supply)



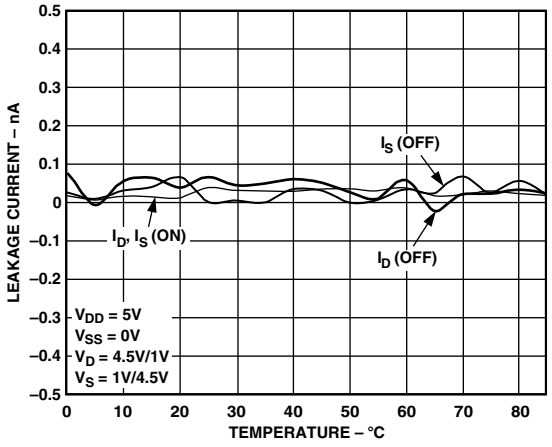
TPC 2. On Resistance vs. V_D (V_S). (Single Supply)



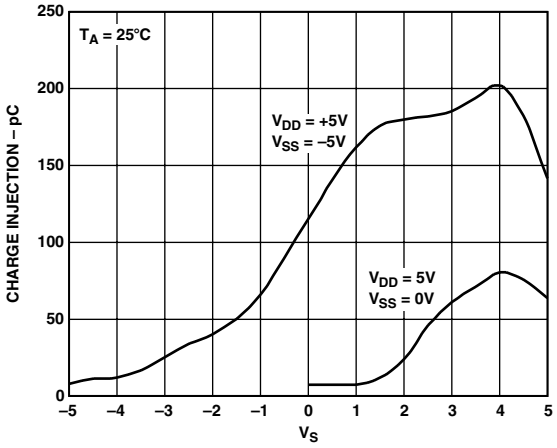
TPC 5. Leakage Currents vs. Temperature. (Dual Supply)



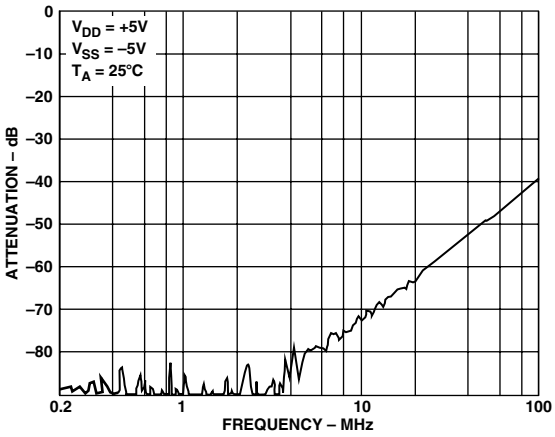
TPC 3. On Resistance vs. V_D (V_S) for Different Temperatures. (Dual Supply)



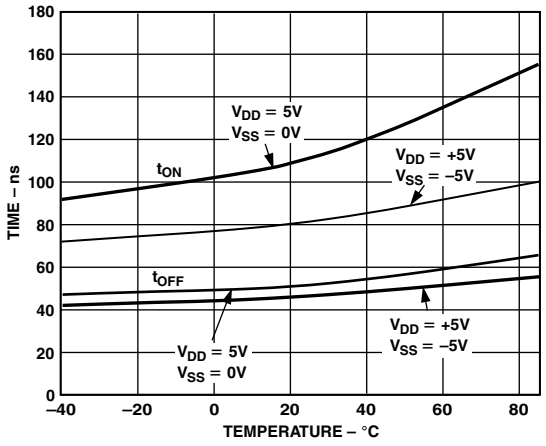
TPC 6. Leakage Currents vs. Temperature. (Single Supply)



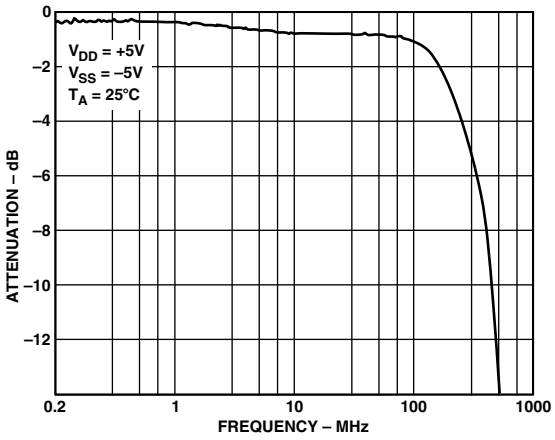
TPC 7. Charge Injection vs. Source Voltage



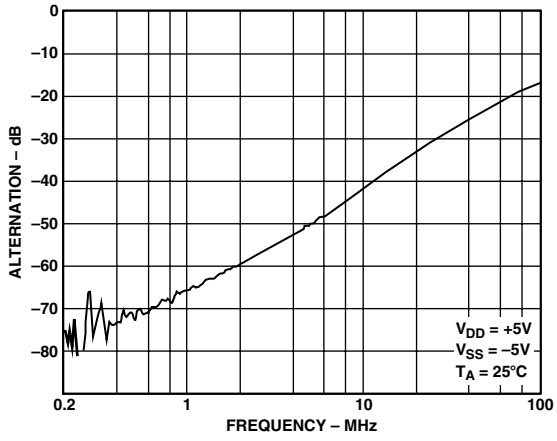
TPC 10. Crosstalk vs. Frequency



TPC 8. t_{ON} / t_{OFF} Times vs. Temperature

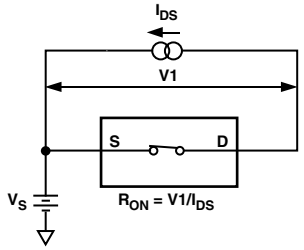


TPC 11. On Response vs. Frequency

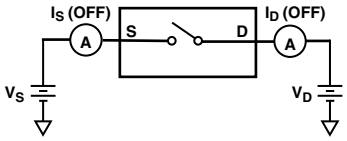


TPC 9. OFF Isolation vs. Frequency

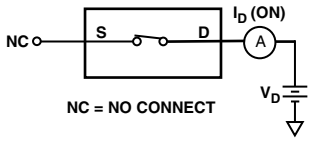
Test Circuits



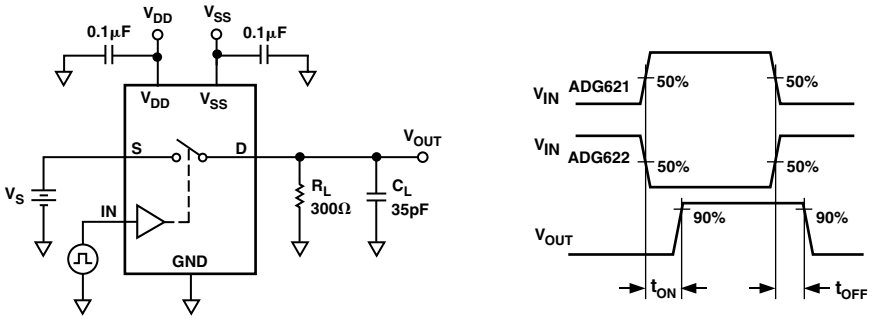
Test Ciruit 1. On Resistance



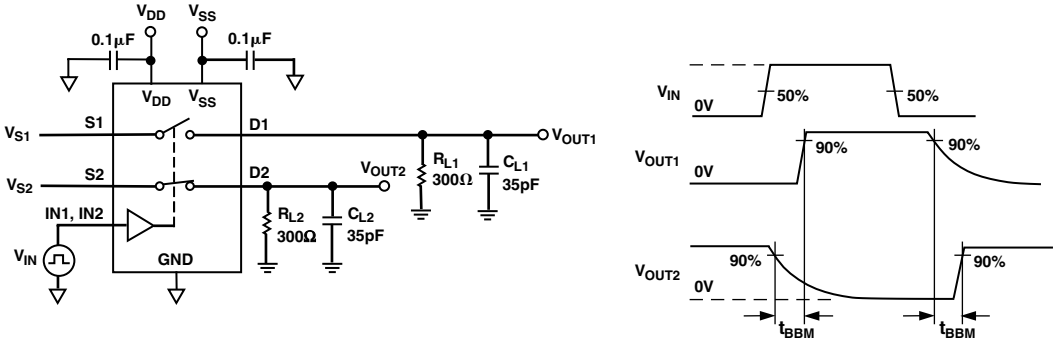
Test Ciruit 2. Off Leakage



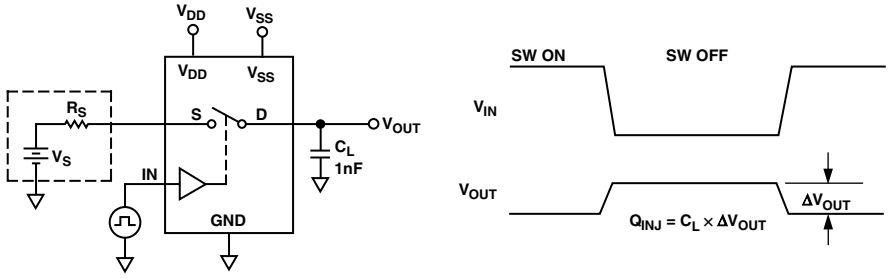
Test Ciruit 3. On Leakage



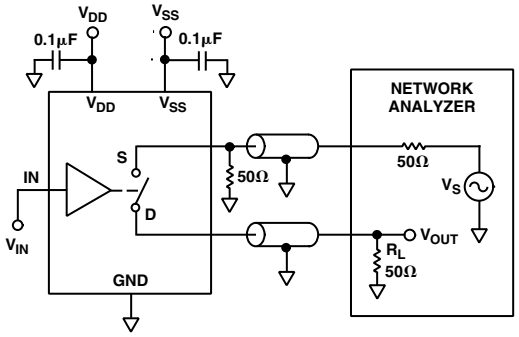
Test Ciruit 4. Switching Times



Test Ciruit 5. Break-Before-Make Time Delay, t_{BBM} (ADG623 Only)

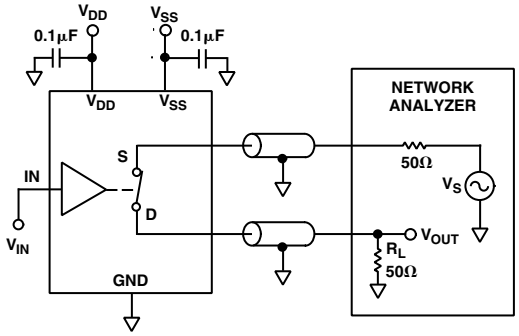


Test Ciruit 6. Charge Injection



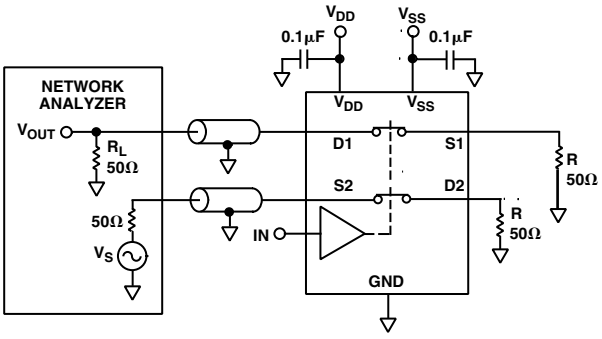
$$\text{OFF ISOLATION} = 20 \log \frac{V_{OUT}}{V_S}$$

Test Ciruit 7. Off Isolation



$$\text{INSERTION LOSS} = 20 \log \frac{V_{OUT} \text{ WITH SWITCH}}{V_{OUT} \text{ WITHOUT SWITCH}}$$

Test Ciruit 9. Bandwidth



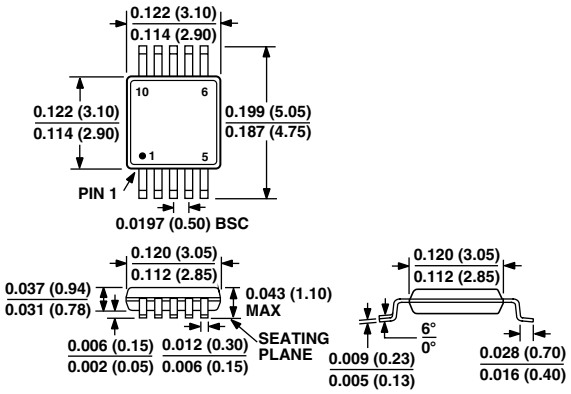
$$\text{CHANNEL-TO-CHANNEL CROSSTALK} = 20 \log \frac{V_{OUT}}{V_S}$$

Test Ciruit 8. Channel-to-Channel Crosstalk

OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

10-Lead μSOIC Package
(RM-10)



C02616–.8–10/01(0)

PRINTED IN U.S.A.