

## FEATURES

**5.5  $\Omega$  (maximum) on resistance**  
**0.9  $\Omega$  (maximum) on resistance flatness**  
**2.7 V to 5.5 V single supply**  
 **$\pm 2.7$  V to  $\pm 5.5$  V dual supply**  
**Rail-to-rail operation**  
**10-lead MSOP package**  
**Typical power consumption ( $<0.01$   $\mu$ W)**  
**TTL-/CMOS-compatible inputs**

## APPLICATIONS

**Automatic test equipment**  
**Power routing**  
**Communication systems**  
**Data acquisition systems**  
**Sample-and-hold systems**  
**Avionics**  
**Relay replacements**  
**Battery-powered systems**

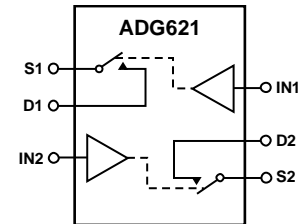
## GENERAL DESCRIPTION

The ADG621/ADG622/ADG623 are monolithic, CMOS, single-pole, single-throw (SPST) switches. Each switch of the ADG621/ADG622/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. In the ADG623, Switch 1 is normally open, and Switch 2 is normally closed. The ADG623 exhibits break-before-make switching action.

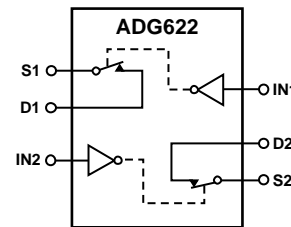
The ADG621/ADG622/ADG623 offer low on resistance of 4  $\Omega$ , which is matched to within 0.25  $\Omega$  between channels. These switches also provide low power dissipation yet give high switching speeds. The ADG621/ADG622/ADG623 are available in a 10-lead MSOP package.

## FUNCTIONAL BLOCK DIAGRAMS



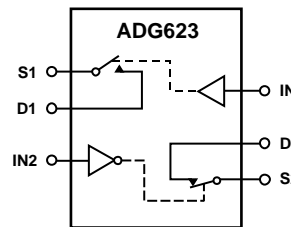
NOTES  
1. SWITCHES SHOWN FOR A LOGIC 0 INPUT

Figure 1.



NOTES  
1. SWITCHES SHOWN FOR A LOGIC 0 INPUT

Figure 2.



NOTES  
1. SWITCHES SHOWN FOR A LOGIC 0 INPUT

Figure 3.

## PRODUCT HIGHLIGHTS

1. Low on resistance,  $R_{ON}$  (4  $\Omega$  typical).
2. Dual  $\pm 2.7$  V to  $\pm 5.5$  V or single +2.7 V to +5.5 V.
3. Low power dissipation; CMOS construction ensures low power dissipation.
4. Tiny 10-lead MSOP package.

### Rev. B

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## REVISION HISTORY

### 11/09—Rev. A to Rev. B

Changes to Table 5.....	5
Changes to Ordering Guide .....	12

### 6/07—Rev. 0 to Rev. A

Change to On Resistance Flatness, $R_{\text{FLAT(ON)}}$ Specification (Table 1).....	3
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Changes to Ordering Guide .....	12

### 11/01—Revision 0: Initial Version

# SPECIFICATIONS

## DUAL SUPPLY<sup>1</sup>

$V_{DD} = +5\text{ V} \pm 10\%$ ,  $V_{SS} = -5\text{ V} \pm 10\%$ , GND = 0 V, unless otherwise noted.

**Table 1.**

Parameter	+25°C	-40°C to +85°C	Unit	Test Conditions/Comments
<b>ANALOG SWITCH</b>				
Analog Signal Range		$V_{SS}$ to $V_{DD}$	V	$V_{DD} = +4.5\text{ V}$ , $V_{SS} = -4.5\text{ V}$
On Resistance, $R_{ON}$	4		$\Omega$ typ	$V_S = \pm 4.5\text{ V}$ , $I_S = -10\text{ mA}$ , see Figure 16
	5.5	7	$\Omega$ max	
On Resistance Match Between Channels, $\Delta R_{ON}$	0.25		$\Omega$ typ	$V_S = \pm 4.5\text{ V}$ , $I_S = -10\text{ mA}$
	0.35	0.4	$\Omega$ max	
On Resistance Flatness, $R_{FLAT(ON)}$	0.9	0.9	$\Omega$ typ	$V_S = \pm 3.3\text{ V}$ , $I_S = -10\text{ mA}$
		1.5	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>				
Source Off Leakage, $I_S$ (Off)	$\pm 0.01$		nA typ	$V_{DD} = +5.5\text{ V}$ , $V_{SS} = -5.5\text{ V}$
	$\pm 0.25$	$\pm 1$	nA max	$V_S = \pm 4.5\text{ V}$ , $V_D = \mp 4.5\text{ V}$ , see Figure 17
Drain Off Leakage, $I_D$ (Off)	$\pm 0.01$		nA typ	$V_S = \pm 4.5\text{ V}$ , $V_D = \mp 4.5\text{ V}$ , see Figure 17
	$\pm 0.25$	$\pm 1$	nA max	
Channel On Leakage, $I_D$ , $I_S$ (On)	$\pm 0.01$		nA typ	$V_S = V_D = \pm 4.5\text{ V}$ , see Figure 18
	$\pm 0.25$	$\pm 1$	nA max	
<b>DIGITAL INPUTS</b>				
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		$\mu\text{A}$ typ	$V_{IN} = V_{INL}$ or $V_{INH}$
		$\pm 0.1$	$\mu\text{A}$ max	
Digital Input Capacitance, $C_{IN}$	2		pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>				
$t_{ON}$	75		ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ ; $V_S = 3.3\text{ V}$ , see Figure 19
	120	155	ns max	
$t_{OFF}$	45		ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ ; $V_S = 3.3\text{ V}$ , see Figure 19
	70	85	ns max	
Break-Before-Make Time Delay, $t_{BBM}$ (ADG623 Only)	30		ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ ; $V_{S1} = V_{S2} = 3.3\text{ V}$
		10	ns min	See Figure 20
Charge Injection	110		pC typ	$V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ , see Figure 21
Off Isolation	-65		dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , see Figure 22
Channel-to-Channel Crosstalk	-90		dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , see Figure 23
Bandwidth -3 dB	230		MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , see Figure 24
$C_S$ (Off)	20		pF typ	$f = 1\text{ MHz}$
$C_D$ (Off)	20		pF typ	$f = 1\text{ MHz}$
$C_D$ , $C_S$ (On)	70		pF typ	$f = 1\text{ MHz}$
<b>POWER REQUIREMENTS</b>				
$I_{DD}$	0.001		$\mu\text{A}$ typ	$V_{DD} = 5.5\text{ V}$ , $V_{SS} = -5.5\text{ V}$
		1.0	$\mu\text{A}$ max	Digital inputs = 0 V or 5.5 V
$I_{SS}$	0.001		$\mu\text{A}$ typ	Digital inputs = 0 V or 5.5 V
		1.0	$\mu\text{A}$ max	

<sup>1</sup> Temperature range is as follows: B version, -40°C to +85°C.

<sup>2</sup> Guaranteed by design; not subject to production test.

# ADG621/ADG622/ADG623

## SINGLE SUPPLY<sup>1</sup>

$V_{DD} = 5\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$ , unless otherwise noted.

**Table 2.**

Parameter	+25°C	-40°C to +85°C	Unit	Test Conditions/Comments
<b>ANALOG SWITCH</b>				
Analog Signal Range		0 to $V_{DD}$	V	$V_{DD} = 4.5\text{ V}$ , $V_{SS} = 0\text{ V}$
On Resistance, $R_{ON}$	7		$\Omega$ typ	$V_S = 0\text{ V}$ to $4.5\text{ V}$ , $I_S = -10\text{ mA}$ , see Figure 16
	10	12.5	$\Omega$ max	
On Resistance Match Between Channels, $\Delta R_{ON}$	0.5		$\Omega$ typ	$V_S = 0\text{ V}$ to $4.5\text{ V}$ , $I_S = -10\text{ mA}$
	0.75	1	$\Omega$ max	
On Resistance Flatness, $R_{FLAT(ON)}$	0.5	0.5	$\Omega$ typ	$V_S = 1.5\text{ V}$ to $3.3\text{ V}$ , $I_S = -10\text{ mA}$
		1.2	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>				
Source Off Leakage $I_S$ (Off)	$\pm 0.01$		nA typ	$V_{DD} = 5.5\text{ V}$ $V_S = 1\text{ V}/4.5\text{ V}$ , $V_D = 4.5\text{ V}/1\text{ V}$ , see Figure 17
	$\pm 0.25$	$\pm 1$	nA max	
Drain Off Leakage $I_D$ (Off)	$\pm 0.01$		nA typ	$V_S = 1\text{ V}/4.5\text{ V}$ , $V_D = 4.5\text{ V}/1\text{ V}$ , see Figure 17
	$\pm 0.25$	$\pm 1$	nA max	
Channel On Leakage, $I_D$ , $I_S$ (On)	$\pm 0.01$		nA typ	$V_S = V_D = 1\text{ V}/4.5\text{ V}$ , see Figure 18
	$\pm 0.25$	$\pm 1$	nA max	
<b>DIGITAL INPUTS</b>				
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		$\mu\text{A}$ typ	$V_{IN} = V_{INL}$ or $V_{INH}$
		$\pm 0.1$	$\mu\text{A}$ max	
Digital Input Capacitance, $C_{IN}$	2		pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>				
$t_{ON}$	120		ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ ; $V_S = 3.3\text{ V}$ , see Figure 19
	210	260	ns max	
$t_{OFF}$	50		ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ ; $V_S = 3.3\text{ V}$ , see Figure 19
	75	100	ns max	
Break-Before-Make Time Delay, $t_{BBM}$ (ADG623 Only)	70		ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_{S1} = V_{S2} = 3.3\text{ V}$
		10	ns min	See Figure 20
Charge Injection	6		pC typ	$V_S = 0\text{ V}$ ; $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ , see Figure 21
Off Isolation	-65		dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , see Figure 22
Channel-to-Channel Crosstalk	-90		dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ , see Figure 23
Bandwidth -3 dB	230		MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , see Figure 24
$C_S$ (Off)	20		pF typ	$f = 1\text{ MHz}$
$C_D$ (Off)	20		pF typ	$f = 1\text{ MHz}$
$C_D$ , $C_S$ (On)	70		pF typ	$f = 1\text{ MHz}$
<b>POWER REQUIREMENTS</b>				
$I_{DD}$	0.001		$\mu\text{A}$ typ	$V_{DD} = 5.5\text{ V}$ Digital Inputs = 0 V or 5.5 V
		1.0	$\mu\text{A}$ max	

<sup>1</sup> Temperature range is as follows: B Version, -40°C to +85°C.

<sup>2</sup> Guaranteed by design; not subject to production test.

## ABSOLUTE MAXIMUM RATINGS

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

**Table 3.**

Parameter	Rating
$V_{DD}$ 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 <sup>1</sup>	$V_{SS} - 0.3\text{ V}$ to $V_{DD} + 0.3\text{ V}$
Digital Inputs <sup>1</sup>	-0.3 V to $V_{DD} + 0.3\text{ V}$ or 30 mA, whichever occurs first
Peak Current, S or D	100 mA (pulsed at 1 ms, 10% duty cycle maximum)
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
MSOP Package	
$\theta_{JA}$ Thermal Impedance	206°C/W
$\theta_{JC}$ Thermal Impedance	44°C/W
Lead Soldering	
Lead Temperature, Soldering (10 sec)	300°C
IR Reflow, Peak Temperature	220°C
Pb-Free Soldering	
Reflow, Peak Temperature	260(+0/-5)°C
Time at Peak Temperature	20 sec to 40 sec

<sup>1</sup> Overvoltages at INx, S, or D must be clamped by internal diodes. Currents should be limited to the maximum ratings given.

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.

**Table 4. ADG621/ADG622 Truth Table**

ADG621 INx	ADG622 INx	Switch Sx Condition
0	1	Off
1	0	On

**Table 5. ADG623 Truth Table**

IN1	IN2	Switch S1	Switch S2
0	0	Off	On
0	1	Off	Off
1	0	On	On
1	1	On	Off

### 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.

# ADG621/ADG622/ADG623

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

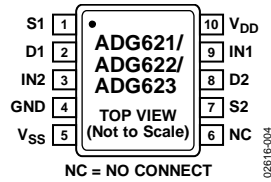


Figure 4. 10-Lead MSOP (RM-10)

Table 6. Pin Function Descriptions

Pin No.	Mnemonic	Description
1, 7	S1, S2	Source Terminal. May be an input or an output.
2, 8	D1, D2	Drain Terminal. May be an input or an output.
3, 9	IN2, IN1	Control Input.
4	GND	Ground (0 V) Reference.
5	V <sub>SS</sub>	Most Negative Power Supply in a Dual-Supply Application. In single-supply applications, this should be tied to ground at the device.
6	NC	No Connect.
10	V <sub>DD</sub>	Most Positive Power Supply Potential.

## TERMINOLOGY

$I_{DD}$

Positive supply current.

$I_{SS}$

Negative supply current

$V_D (V_S)$

Analog voltage on Terminal D and Terminal S.

$R_{ON}$

Ohmic resistance between Terminal D and Terminal S.

$R_{FLAT (ON)}$

On resistance flatness is defined as the difference between the maximum and minimum value of on resistance as measured over the specified analog signal range.

$\Delta R_{ON}$

On resistance match between any two channels.

$I_S (Off)$

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.

$V_{INL}$

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. Measured with reference to ground.

$C_D (Off)$

Off switch drain capacitance. Measured with reference to ground.

$C_D, C_S (On)$

On switch capacitance. Measured with reference to ground.

$C_{IN}$

Digital input capacitance.

$t_{ON}$

Delay time between the 50% and the 90% points of the digital input and switch on condition.

$t_{OFF}$

Delay time between the 50% and the 90% points of the digital input and switch off condition.

$t_{BBM}$

On or off 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 transferred from the digital input to the analog output during on-off switching.

### Off Isolation

A measure of an unwanted signal coupling through an off switch.

### Crosstalk

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

### -3 dB Bandwidth

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

### On Response

The frequency response of the on switch.

### Insertion Loss

The attenuation between the input and output ports of the switch when the switch is in the on condition and is due to the on resistance of the switch.

TYPICAL PERFORMANCE CHARACTERISTICS

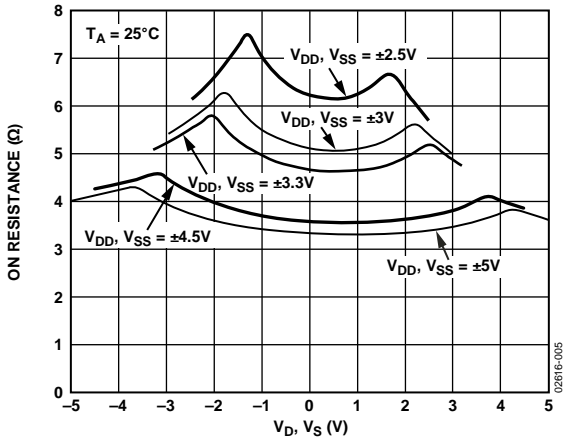


Figure 5. On Resistance vs.  $V_D$ ,  $V_S$  (Dual Supply)

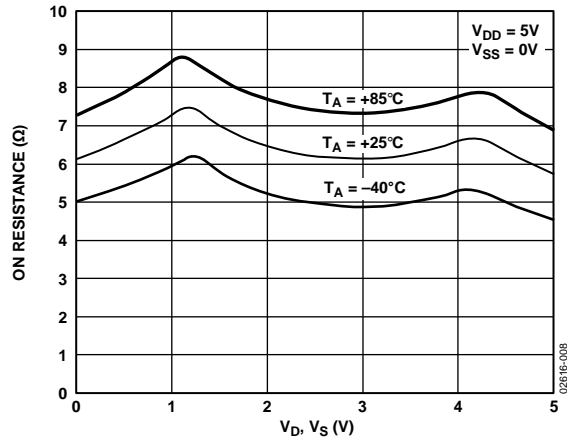


Figure 8. On Resistance vs.  $V_D$ ,  $V_S$  for Different Temperature (Single Supply)

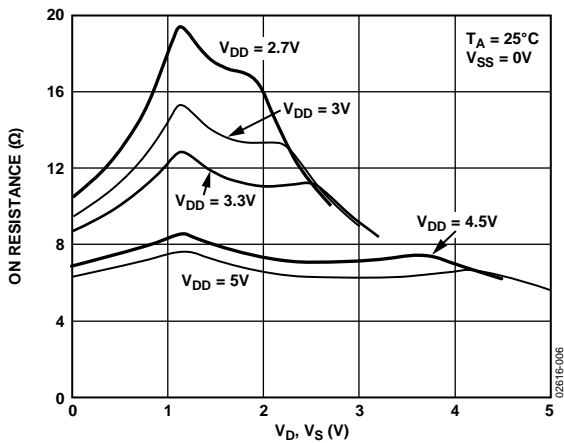


Figure 6. On Resistance vs.  $V_D$ ,  $V_S$  (Single Supply)

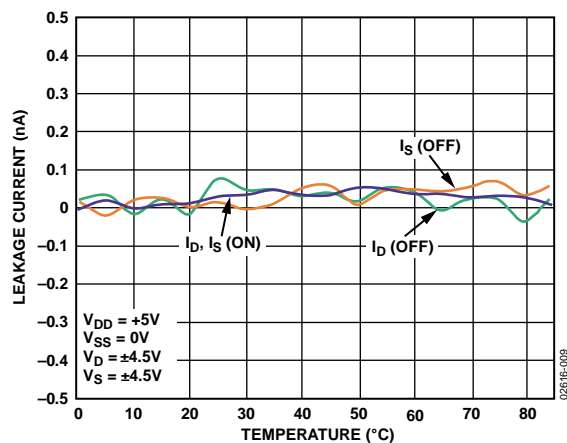


Figure 9. Leakage Current vs. Temperature (Dual Supply)

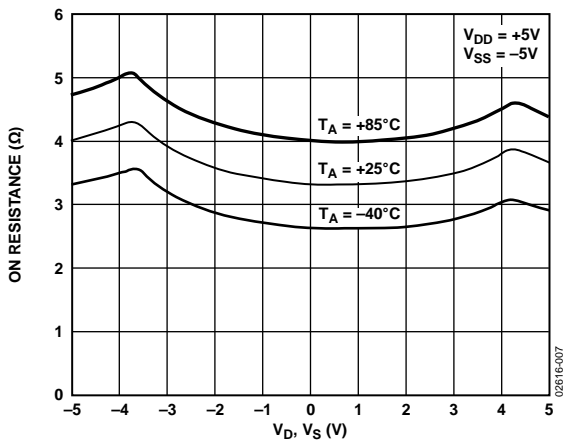


Figure 7. On Resistance vs.  $V_D$ ,  $V_S$  for Different Temperatures (Dual Supply)

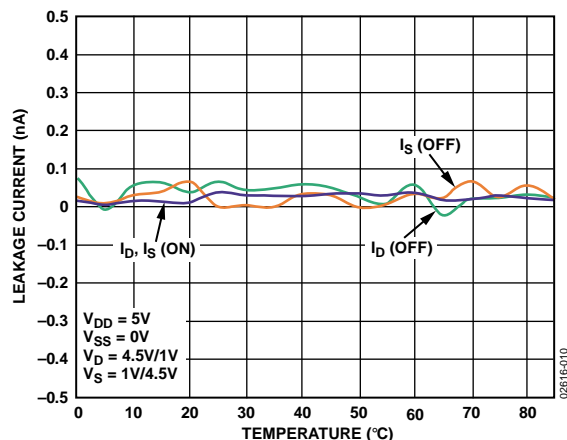


Figure 10. Leakage Current vs. Temperature (Single Supply)



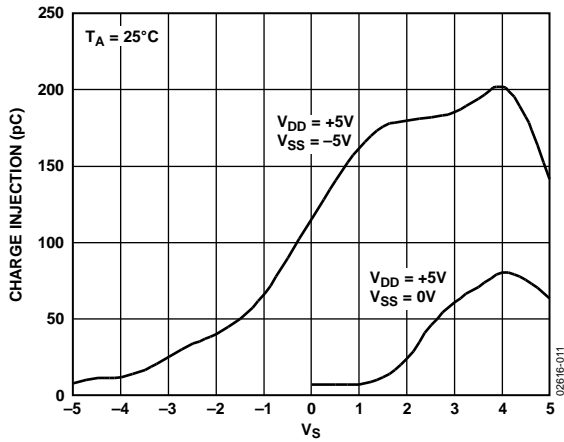


Figure 11. Charge Injection vs. Source Voltage

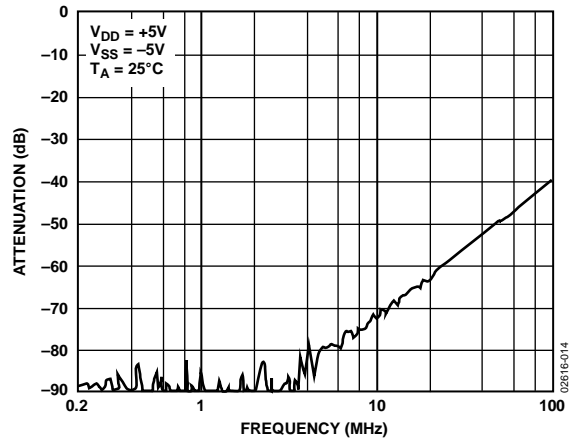


Figure 14. Crosstalk vs. Frequency

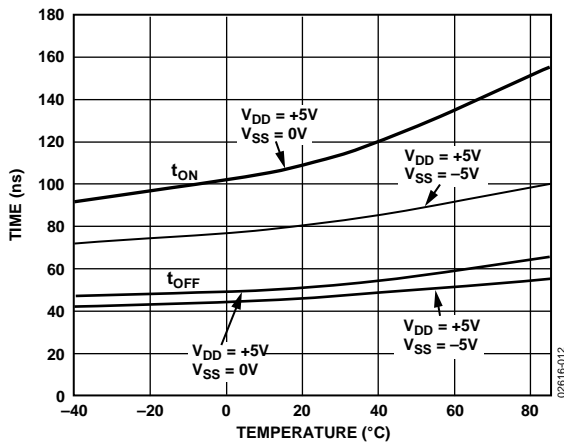


Figure 12.  $t_{ON}/t_{OFF}$  Times vs. Temperature

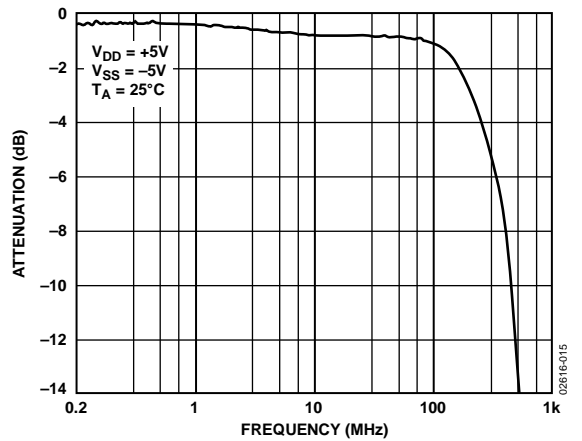


Figure 15. On Response vs. Frequency

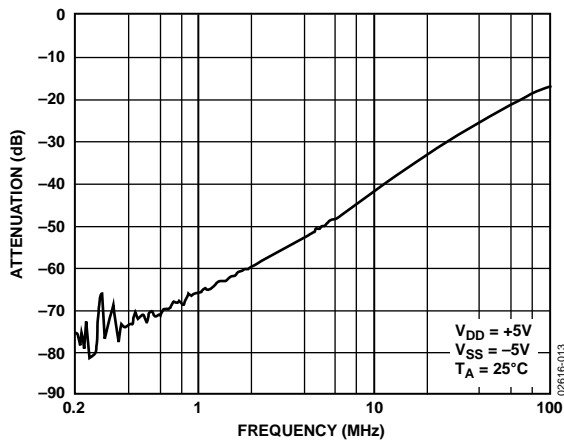


Figure 13. Off Isolation vs. Frequency

## TEST CIRCUITS

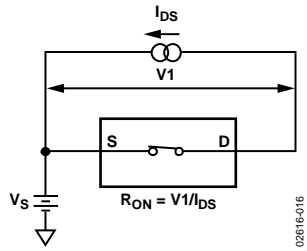


Figure 16. On Resistance

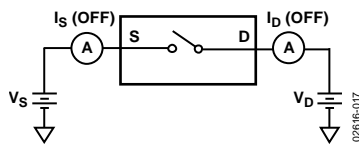


Figure 17. Off Leakage

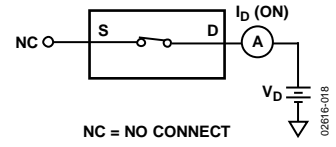


Figure 18. On Leakage

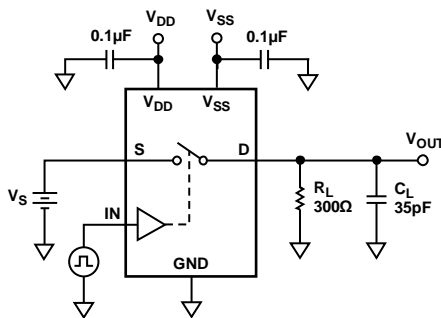


Figure 19. Switching Times ( $t_{ON}$ ,  $t_{OFF}$ )

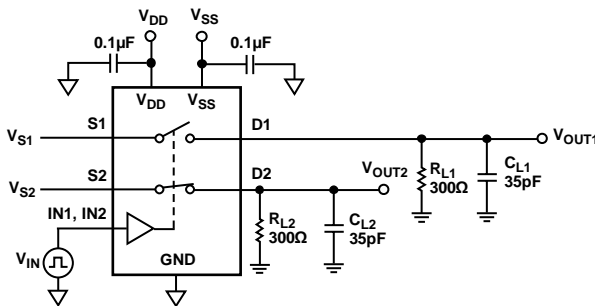
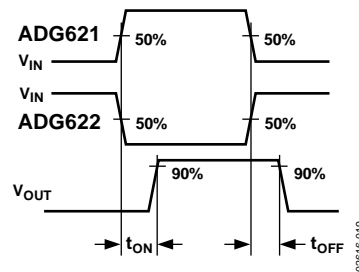


Figure 20. Break-Before-Make Time Delay,  $t_{BBM}$  (ADG623 Only)

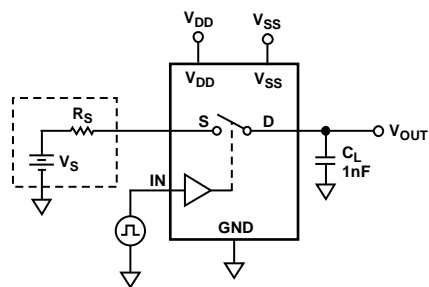
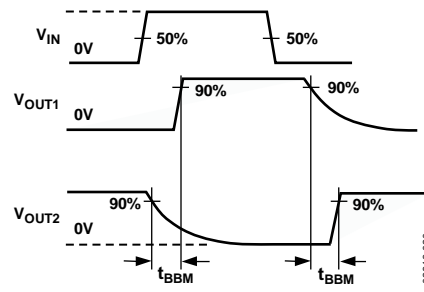
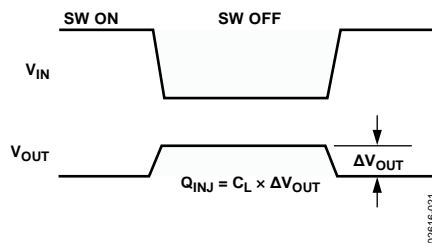


Figure 21. Charge Injection



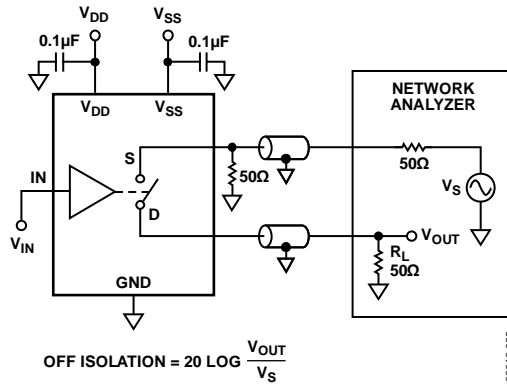


Figure 22. Off Isolation

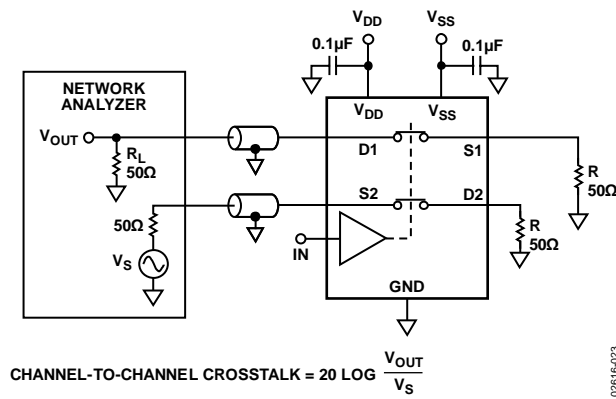


Figure 23. Channel-to-Channel Crosstalk

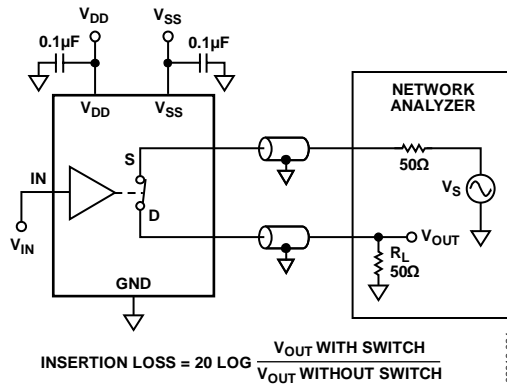
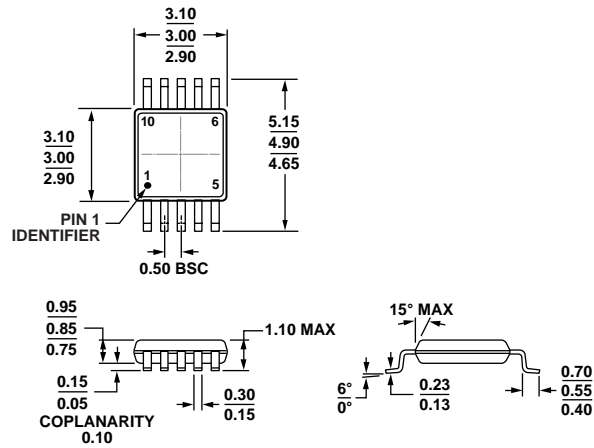


Figure 24. Bandwidth

# ADG621/ADG622/ADG623

## OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-187-BA

Figure 25. 10-Lead Mini Small Outline Package [MSOP] (RM-10)

Dimensions shown in millimeters

081708-A

## ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option	Branding
ADG621BRM	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SXB
ADG621BRM-REEL7	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SXB
ADG621BRMZ <sup>1</sup>	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SXB#
ADG621BRMZ-REEL <sup>1</sup>	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SXB#
ADG622BRM	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SYB
ADG622BRM-REEL	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SYB
ADG622BRM-REEL7	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SYB
ADG622BRMZ <sup>1</sup>	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	S12
ADG622BRMZ-REEL <sup>1</sup>	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	S12
ADG622BRMZ-REEL7 <sup>1</sup>	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	S12
ADG623BRM	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SZB
ADG623BRM-REEL	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SZB
ADG623BRM-REEL7	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SZB
ADG623BRMZ <sup>1</sup>	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SZB#
ADG623BRMZ-REEL <sup>1</sup>	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SZB#
ADG623BRMZ-REEL7 <sup>1</sup>	-40°C to +85°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	SZB#

<sup>1</sup> Z= RoHS Compliant Part, # denotes RoHS compliant product and may be top or bottom marked.