

## FEATURES

Latch-up immune under all circumstances  
 Human body model (HBM) ESD rating: 8 kV  
 Low on resistance: 13.5  $\Omega$   
 $\pm 9$  V to  $\pm 22$  V dual-supply operation  
 9 V to 40 V single-supply operation  
 48 V supply maximum ratings  
 Fully specified at  $\pm 15$  V,  $\pm 20$  V, +12 V, and +36 V  
 $V_{DD}$  to  $V_{SS}$  analog signal range

## APPLICATIONS

High voltage signal routing  
 Automatic test equipment  
 Analog front-end circuits  
 Precision data acquisition  
 Industrial instrumentation  
 Amplifier gain select  
 Relay replacement

## GENERAL DESCRIPTION

The **ADG5419** is a monolithic industrial, complementary metal oxide semiconductor (CMOS) analog switch containing a latch-up immune single-pole/double-throw (SPDT) switch.

Each switch conducts equally well in both directions when on, and each switch has an input signal range that extends to the power supplies. In the off condition, signal levels up to the supplies are blocked. The **ADG5419** exhibits break-before-make switching action for use in multiplexer applications.

The ultralow on resistance and on-resistance flatness of these switches make them ideal solutions for data acquisition and gain switching applications where low distortion is critical. The latch-up immune construction and high ESD rating make these switches more robust in harsh environments.

## FUNCTIONAL BLOCK DIAGRAMS

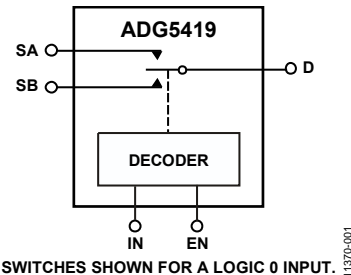


Figure 1. 8-Lead LFCSP

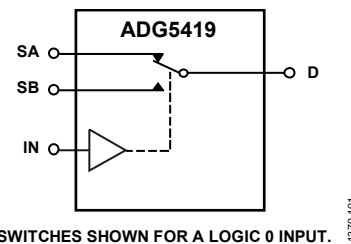


Figure 2. 8-Lead MSOP

## PRODUCT HIGHLIGHTS

1. Trench isolation guards against latch-up. A dielectric trench separates the P channel and N channel transistors, thereby preventing latch-up even under severe overvoltage conditions.
2. Low  $R_{ON}$  of 13.5  $\Omega$ .
3. Dual-supply operation. For applications where the analog signal is bipolar, the **ADG5419** can be operated from dual supplies up to  $\pm 22$  V.
4. Single-supply operation. For applications where the analog signal is unipolar, the **ADG5419** can be operated from a single-rail power supply up to 40 V.
5. 3 V logic compatible digital inputs:  $V_{INH} = 2.0$  V,  $V_{INL} = 0.8$  V.
6. No  $V_I$  logic power supply required.
7. Available in 8-lead MSOP and 8-lead, 2 mm  $\times$  3 mm LFCSP packages.

Rev. A

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## REVISION HISTORY

### 3/15—Rev. 0 to Rev. A

Added 8-Lead LFCSP.....	Universal	Added Figure 23 .....	13
Added Figure 1; Renumbered Sequentially .....	1	Changes to Figure 24 Caption .....	14
Changes to Table 1.....	3	Added Figure 25 and Figure 26 .....	14
Changes to Table 2.....	4	Deleted Figure 27; Renumbered Sequentially .....	14
Changes to Table 3.....	5	Added Figure 32 and Figure 33 .....	15
Changes to Table 4.....	6	Changes to Terminology Section .....	17
Changed Continuous Current, Sx or D to 8-Lead MSOP, Table 5 .....	7	Added Figure 37, Outline Dimensions.....	19
Added Figure 3 and Table 8; Renumbered Sequentially .....	9	Changes to Ordering Guide.....	19
Changes to Table 7.....	9		
Changes to Figure 5.....	10		

### 9/13—Revision 0: Initial Version

## SPECIFICATIONS

## ±15 V DUAL SUPPLY

$V_{DD} = +15\text{ V} \pm 10\%$ ,  $V_{SS} = -15\text{ V} \pm 10\%$ , GND = 0 V, unless otherwise noted.

Table 1.

Parameter	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
<b>ANALOG SWITCH</b>					
Analog Signal Range			$V_{DD}$ to $V_{SS}$	V	
On Resistance, $R_{ON}$	13.5			$\Omega$ typ	$V_S = \pm 10\text{ V}$ , $I_S = -10\text{ mA}$ ; see Figure 27
	15	19	23	$\Omega$ max	$V_{DD} = +13.5\text{ V}$ , $V_{SS} = -13.5\text{ V}$
On-Resistance Match Between Channels, $\Delta R_{ON}$	0.1			$\Omega$ typ	$V_S = \pm 10\text{ V}$ , $I_S = -10\text{ mA}$
	0.8	1.3	1.4	$\Omega$ max	
On-Resistance Flatness, $R_{FLAT(ON)}$	1.8			$\Omega$ typ	$V_S = \pm 10\text{ V}$ , $I_S = -10\text{ mA}$
	2.2	2.7	3.1	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_S$ (Off)	$\pm 0.1$			nA typ	$V_{DD} = +16.5\text{ V}$ , $V_{SS} = -16.5\text{ V}$ $V_S = \pm 10\text{ V}$ , $V_D = \mp 10\text{ V}$ ; see Figure 24 and Figure 25
	$\pm 0.25$	$\pm 1$	$\pm 10$	nA max	
Drain Off Leakage, $I_D$ (Off)	$\pm 0.1$			nA typ	$V_S = \pm 10\text{ V}$ , $V_D = \mp 10\text{ V}$ ; see Figure 25
	$\pm 0.4$	$\pm 4$	$\pm 10$	nA max	
Channel On Leakage, $I_D$ (On), $I_S$ (On)	$\pm 0.1$			nA typ	$V_S = V_D = \pm 10\text{ V}$ ; see Figure 24 and Figure 26
	$\pm 0.4$	$\pm 4$	$\pm 10$	nA max	
<b>DIGITAL INPUTS</b>					
Input High Voltage, $V_{INH}$			2.0	V min	
Input Low Voltage, $V_{INL}$			0.8	V max	
Input Current, $I_{INL}$ or $I_{INH}$	0.002			$\mu\text{A}$ typ	$V_{IN} = V_{GND}$ or $V_{DD}$
			$\pm 0.1$	$\mu\text{A}$ max	
Digital Input Capacitance, $C_{IN}$	6			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
Transition Time, $t_{TRANSITION}$	217			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	260	310	336	ns max	$V_S = 10\text{ V}$ ; see Figure 32
$t_{ON}$ (EN)	179			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	212	261	298	ns max	$V_S = 10\text{ V}$ ; see Figure 33
$t_{OFF}$ (EN)	153			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	176	195	209	ns max	$V_S = 10\text{ V}$ ; see Figure 33
Break-Before-Make Time Delay, $t_D$	86			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
			45	ns min	$V_S = 10\text{ V}$ ; see Figure 34
Charge Injection, $Q_{INJ}$	130			pC typ	$V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 35
Off Isolation	-60			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 29
Channel-to-Channel Crosstalk	-80			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 28
Total Harmonic Distortion + Noise	0.01			% typ	$R_L = 1\text{ k}\Omega$ , 15 V p-p, $f = 20\text{ Hz}$ to 20 kHz; see Figure 30
-3 dB Bandwidth	190			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 31
Insertion Loss	-0.8			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 31
$C_S$ (Off)	12			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (Off)	23			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (On), $C_S$ (On)	55			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
<b>POWER REQUIREMENTS</b>					
$I_{DD}$	45			$\mu\text{A}$ typ	$V_{DD} = +16.5\text{ V}$ , $V_{SS} = -16.5\text{ V}$ Digital inputs = 0 V or $V_{DD}$
	55		70	$\mu\text{A}$ max	
$I_{SS}$	0.001			$\mu\text{A}$ typ	Digital inputs = 0 V or $V_{DD}$
			1	$\mu\text{A}$ max	
$V_{DD}/V_{SS}$			$\pm 9/\pm 22$	V min/V max	GND = 0 V

<sup>1</sup> Guaranteed by design; not subject to production test.

**±20 V DUAL SUPPLY**

$V_{DD} = +20\text{ V} \pm 10\%$ ,  $V_{SS} = -20\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ , unless otherwise noted.

**Table 2.**

Parameter	25°C	−40°C to +85°C	−40°C to +125°C	Unit	Test Conditions/Comments
<b>ANALOG SWITCH</b>					
Analog Signal Range			$V_{DD}$ to $V_{SS}$	V	
On Resistance, $R_{ON}$	12.5			$\Omega$ typ	$V_S = \pm 15\text{ V}$ , $I_S = -10\text{ mA}$ ; see Figure 27
On-Resistance Match Between Channels, $\Delta R_{ON}$	14	18	22	$\Omega$ max	$V_{DD} = +18\text{ V}$ , $V_{SS} = -18\text{ V}$
	0.1			$\Omega$ typ	$V_S = \pm 15\text{ V}$ , $I_S = -10\text{ mA}$
On-Resistance Flatness, $R_{FLAT(ON)}$	0.8	1.3	1.4	$\Omega$ max	
	2.3			$\Omega$ typ	$V_S = \pm 15\text{ V}$ , $I_S = -10\text{ mA}$
	2.7	3.3	3.7	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_S$ (Off)	$\pm 0.1$			nA typ	$V_{DD} = +22\text{ V}$ , $V_{SS} = -22\text{ V}$ $V_S = \pm 15\text{ V}$ , $V_D = \mp 15\text{ V}$ ; see Figure 24 and Figure 25
Drain Off Leakage, $I_D$ (Off)	$\pm 0.25$ $\pm 0.1$	$\pm 1$	$\pm 10$	nA max nA typ	$V_S = \pm 15\text{ V}$ , $V_D = \mp 15\text{ V}$ ; see Figure 25
Channel On Leakage, $I_D$ (On), $I_S$ (On)	$\pm 0.4$ $\pm 0.1$	$\pm 4$	$\pm 10$	nA max nA typ	$V_S = V_D = \pm 15\text{ V}$ ; see Figure 24 and Figure 26
	$\pm 0.4$	$\pm 4$	$\pm 10$	nA max	
<b>DIGITAL INPUTS</b>					
Input High Voltage, $V_{INH}$			2.0	V min	
Input Low Voltage, $V_{INL}$			0.8	V max	
Input Current, $I_{INL}$ or $I_{INH}$	0.002			$\mu\text{A}$ typ	$V_{IN} = V_{GND}$ or $V_{DD}$
Digital Input Capacitance, $C_{IN}$	6		$\pm 0.1$	$\mu\text{A}$ max pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
Transition Time, $t_{TRANSITION}$	200			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	235	279	294	ns max	$V_S = 10\text{ V}$ ; see Figure 32
$t_{ON}$ (EN)	199			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	239	300	344	ns max	$V_S = 10\text{ V}$ ; see Figure 33
$t_{OFF}$ (EN)	157			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	185	208	227	ns max	$V_S = 10\text{ V}$ ; see Figure 33
Break-Before-Make Time Delay, $t_D$	77		46	ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
				ns min	$V_S = 10\text{ V}$ ; see Figure 34
Charge Injection, $Q_{INJ}$	160			pC typ	$V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 35
Off Isolation	−60			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 29
Channel-to-Channel Crosstalk	−80			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 28
Total Harmonic Distortion + Noise	0.01			% typ	$R_L = 1\text{ k}\Omega$ , 20 V p-p, $f = 20\text{ Hz}$ to 20 kHz; see Figure 30
−3 dB Bandwidth	190			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 31
Insertion Loss	−0.7			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 31
$C_S$ (Off)	11			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (Off)	22			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (On), $C_S$ (On)	55			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
<b>POWER REQUIREMENTS</b>					
$I_{DD}$	50			$\mu\text{A}$ typ	$V_{DD} = +22\text{ V}$ , $V_{SS} = -22\text{ V}$ Digital inputs = 0 V or $V_{DD}$
	70		110	$\mu\text{A}$ max	
$I_{SS}$	0.001			$\mu\text{A}$ typ	Digital inputs = 0 V or $V_{DD}$
			1	$\mu\text{A}$ max	
$V_{DD}/V_{SS}$			$\pm 9/\pm 22$	V min/V max	$GND = 0\text{ V}$

<sup>1</sup> Guaranteed by design; not subject to production test.

**12 V SINGLE SUPPLY**

$V_{DD} = 12\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$ , unless otherwise noted.

**Table 3.**

Parameter	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
<b>ANALOG SWITCH</b>					
Analog Signal Range			0 V to $V_{DD}$	V	
On Resistance, $R_{ON}$	26			$\Omega$ typ	$V_S = 0\text{ V}$ to 10 V, $I_S = -10\text{ mA}$ ; see Figure 27
	30	38	44	$\Omega$ max	$V_{DD} = 10.8\text{ V}$ , $V_{SS} = 0\text{ V}$
On-Resistance Match Between Channels, $\Delta R_{ON}$	0.1			$\Omega$ typ	$V_S = 0\text{ V}$ to 10 V, $I_S = -10\text{ mA}$
	1	1.5	1.6	$\Omega$ max	
On-Resistance Flatness, $R_{FLAT(ON)}$	5.5			$\Omega$ typ	$V_S = 0\text{ V}$ to 10 V, $I_S = -10\text{ mA}$
	6.8	8.3	12.3	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_S$ (Off)	$\pm 0.1$			nA typ	$V_{DD} = +13.2\text{ V}$ , $V_{SS} = 0\text{ V}$ $V_S = 1\text{ V}$ to 10 V, $V_D = 10\text{ V}$ to 1 V; see Figure 24 and Figure 25
	$\pm 0.25$	$\pm 1$	$\pm 10$	nA max	
Drain Off Leakage, $I_D$ (Off)	$\pm 0.1$			nA typ	$V_S = 1\text{ V}$ to 10 V, $V_D = 10\text{ V}$ to 1 V; see Figure 25
	$\pm 0.4$	$\pm 4$	$\pm 10$	nA max	
Channel On Leakage, $I_D$ (On), $I_S$ (On)	$\pm 0.1$			nA typ	$V_S = V_D = 1\text{ V}$ to 10 V; see Figure 24 and Figure 26
	$\pm 0.4$	$\pm 4$	$\pm 10$	nA max	
<b>DIGITAL INPUTS</b>					
Input High Voltage, $V_{INH}$			2.0	V min	
Input Low Voltage, $V_{INL}$			0.8	V max	
Input Current, $I_{INL}$ or $I_{INH}$	0.002			$\mu\text{A}$ typ	$V_{IN} = V_{GND}$ or $V_{DD}$
			$\pm 0.1$	$\mu\text{A}$ max	
Digital Input Capacitance, $C_{IN}$	6			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
Transition Time, $t_{TRANSITION}$	333			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	414	508	567	ns max	$V_S = 8\text{ V}$ ; see Figure 32
$t_{ON}$ (EN)	327			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	410	526	612	ns max	$V_S = 8\text{ V}$ ; see Figure 33
$t_{OFF}$ (EN)	166			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	200	528	611	ns max	$V_S = 8\text{ V}$ ; see Figure 33
Break-Before-Make Time Delay, $t_D$	176			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
			97	ns min	$V_S = 8\text{ V}$ ; see Figure 34
Charge Injection, $Q_{INJ}$	55			pC typ	$V_S = 6\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 35
Off Isolation	-60			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 29
Channel-to-Channel Crosstalk	-80			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 28
Total Harmonic Distortion + Noise	0.03			% typ	$R_L = 1\text{ k}\Omega$ , 6 V p-p, $f = 20\text{ Hz}$ to 20 kHz; see Figure 30
-3 dB Bandwidth	170			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 31
Insertion Loss	-1.7			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 31
$C_S$ (Off)	15			pF typ	$V_S = 6\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (Off)	29			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (On), $C_S$ (On)	50			pF typ	$V_S = 6\text{ V}$ , $f = 1\text{ MHz}$
<b>POWER REQUIREMENTS</b>					
$I_{DD}$	40			$\mu\text{A}$ typ	$V_{DD} = 13.2\text{ V}$
	50		65	$\mu\text{A}$ max	Digital inputs = 0 V or $V_{DD}$
$V_{DD}$			9/40	V min/V max	$GND = 0\text{ V}$ , $V_{SS} = 0\text{ V}$

<sup>1</sup> Guaranteed by design; not subject to production test.

**36 V SINGLE SUPPLY**

$V_{DD} = 36\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$ , unless otherwise noted.

**Table 4.**

Parameter	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
<b>ANALOG SWITCH</b>					
Analog Signal Range			0 V to $V_{DD}$	V	
On Resistance, $R_{ON}$	14.5			$\Omega$ typ	$V_S = 0\text{ V to }30\text{ V}$ , $I_S = -10\text{ mA}$ ; see Figure 27
On-Resistance Match Between Channels, $\Delta R_{ON}$	16 0.1	20	24	$\Omega$ max $\Omega$ typ	$V_{DD} = 32.4\text{ V}$ , $V_{SS} = 0\text{ V}$ $V_S = 0\text{ V to }30\text{ V}$ , $I_S = -10\text{ mA}$
On-Resistance Flatness, $R_{FLAT(ON)}$	0.8 3.5 4.3	1.3	1.4 6.5	$\Omega$ max $\Omega$ typ $\Omega$ max	$V_S = 0\text{ V to }30\text{ V}$ , $I_S = -10\text{ mA}$
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_S$ (Off)	$\pm 0.1$			nA typ	$V_{DD} = 39.6\text{ V}$ , $V_{SS} = 0\text{ V}$ $V_S = 1\text{ V to }30\text{ V}$ , $V_D = 30\text{ V to }1\text{ V}$ ; see Figure 24 and Figure 25
Drain Off Leakage, $I_D$ (Off)	$\pm 0.25$ $\pm 0.1$	$\pm 1$	$\pm 10$	nA max nA typ	$V_S = 1\text{ V to }30\text{ V}$ , $V_D = 30\text{ V to }1\text{ V}$ ; see Figure 25
Channel On Leakage, $I_D$ (On), $I_S$ (On)	$\pm 0.4$ $\pm 0.1$	$\pm 4$	$\pm 10$	nA max nA typ	$V_S = V_D = 1\text{ V to }30\text{ V}$ ; see Figure 24 and Figure 26
	$\pm 0.4$	$\pm 4$	$\pm 10$	nA max	
<b>DIGITAL INPUTS</b>					
Input High Voltage, $V_{INH}$			2.0	V min	
Input Low Voltage, $V_{INL}$			0.8	V max	
Input Current, $I_{INL}$ or $I_{INH}$	0.002			$\mu\text{A}$ typ	$V_{IN} = V_{GND}$ or $V_{DD}$
			$\pm 0.1$	$\mu\text{A}$ max	
Digital Input Capacitance, $C_{IN}$	6			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
Transition Time, $t_{TRANSITION}$	216 250			ns typ ns max	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ $V_S = 18\text{ V}$ ; see Figure 32
$t_{ON}$ (EN)	199 232	286	310	ns typ ns max	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ $V_S = 18\text{ V}$ ; see Figure 33
$t_{OFF}$ (EN)	160 193	279	315	ns typ ns max	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ $V_S = 18\text{ V}$ ; see Figure 33
Break-Before-Make Time Delay, $t_D$	80	284	315	ns typ ns min	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ $V_S = 18\text{ V}$ ; see Figure 34
Charge Injection, $Q_{INJ}$	135		47	pC typ	$V_S = 18\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 35
Off Isolation	-60			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 29
Channel-to-Channel Crosstalk	-80			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 28
Total Harmonic Distortion + Noise	0.01			% typ	$R_L = 1\text{ k}\Omega$ , $18\text{ V p-p}$ , $f = 20\text{ Hz to }20\text{ kHz}$ ; see Figure 30
-3 dB Bandwidth	170			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 31
Insertion Loss	-1			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 31
$C_S$ (Off)	14			pF typ	$V_S = 18\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (Off)	26			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (On), $C_S$ (On)	50			pF typ	$V_S = 18\text{ V}$ , $f = 1\text{ MHz}$
<b>POWER REQUIREMENTS</b>					
$I_{DD}$	80 100			$\mu\text{A}$ typ $\mu\text{A}$ max	$V_{DD} = 39.6\text{ V}$ Digital inputs = 0 V or $V_{DD}$
$V_{DD}$			130 9/40	V min/V max	$GND = 0\text{ V}$ , $V_{SS} = 0\text{ V}$

<sup>1</sup> Guaranteed by design; not subject to production test.

**CONTINUOUS CURRENT PER CHANNEL, S<sub>x</sub> OR D**

Table 5.

Parameter	25°C	85°C	125°C	Unit	Test Conditions/Comments
8-LEAD MSOP					$\theta_{JA} = 133.1^{\circ}\text{C/W}$
$V_{DD} = 15\text{ V}, V_{SS} = -15\text{ V}$	113	73	46	mA maximum	
$V_{DD} = 20\text{ V}, V_{SS} = -20\text{ V}$	118	76	47	mA maximum	
$V_{DD} = 12\text{ V}, V_{SS} = 0\text{ V}$	90	60	41	mA maximum	
$V_{DD} = 36\text{ V}, V_{SS} = 0\text{ V}$	116	74	46	mA maximum	
8-LEAD LFCSP					$\theta_{JA} = 60.88^{\circ}\text{C/W}$
$V_{DD} = 15\text{ V}, V_{SS} = -15\text{ V}$	156	92	52	mA maximum	
$V_{DD} = 20\text{ V}, V_{SS} = -20\text{ V}$	163	95	53	mA maximum	
$V_{DD} = 12\text{ V}, V_{SS} = 0\text{ V}$	126	78	48	mA maximum	
$V_{DD} = 36\text{ V}, V_{SS} = 0\text{ V}$	160	93	53	mA maximum	

## ABSOLUTE MAXIMUM RATINGS

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

**Table 6.**

Parameter	Rating
$V_{DD}$ to $V_{SS}$	48 V
$V_{DD}$ to GND	-0.3 V to +48 V
$V_{SS}$ to GND	+0.3 V to -48 V
Analog Inputs <sup>1</sup>	$V_{SS} - 0.3\text{ V}$ to $V_{DD} + 0.3\text{ V}$ or 30 mA, whichever occurs first
Digital Inputs <sup>1</sup>	$V_{SS} - 0.3\text{ V}$ to $V_{DD} + 0.3\text{ V}$ or 30 mA, whichever occurs first
Peak Current, Sx or D Pins	410 mA (pulsed at 1 ms, 10% duty cycle maximum)
Continuous Current, Sx or D <sup>2</sup>	Data + 15%
Temperature Range	
Operating	-40°C to +125°C
Storage	-65°C to +150°C
Junction Temperature	150°C
Thermal Impedance, $\theta_{JA}$	
8-Lead MSOP (4-Layer Board)	133.1°C/W
8-Lead LFCSP	60.88°C/W
Reflow Soldering Peak Temperature, Pb Free	As per JEDEC J-STD-020
Human Body Model (HBM) ESD	8 kV

<sup>1</sup> Overvoltages at the IN, Sx, and D pins are clamped by internal diodes. Limit current to the maximum ratings given.

<sup>2</sup> See Table 5.

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

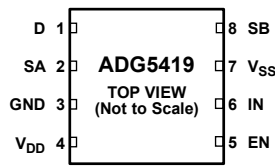
### ESD CAUTION



**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.



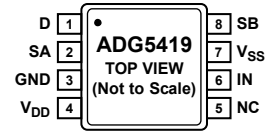
# PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS



NOTES  
1. EXPOSED PAD TIED TO SUBSTRATE,  $V_{SS}$ .

Figure 3. 8-Lead LFCSP Pin Configuration

11370-103



NOTES  
1. NC = NO CONNECT. NOT INTERNALLY CONNECTED.

Figure 4. 8-Lead MSOP Pin Configuration

11370-002

Table 7. Pin Function Descriptions

Pin No.		Mnemonic	Description
LFCSP	MSOP		
1	1	D	Drain Terminal. This pin can be an input or output.
2	2	SA	Source Terminal. This pin can be an input or an output.
3	3	GND	Ground (0 V) Reference.
4	4	$V_{DD}$	Most Positive Power Supply Potential.
5		EN	Active High Digital Input. When this pin is low, the device is disabled and all switches are turned off. When this pin is high, the IN logic input determines the state of the switch.
6	6	IN	Logic Control Input.
7	7	$V_{SS}$	Most Negative Power Supply Potential.
8	8	SB	Source Terminal. This pin can be an input or an output.
	5	NC	No Connect. Not internally connected.
	Not applicable	EPAD	Exposed Pad. Exposed pad tied to substrate, $V_{SS}$ .

Table 8. LFCSP Truth Table

EN	IN	Switch A	Switch B
0	X <sup>1</sup>	Off	Off
1	0	On	Off
1	1	Off	On

<sup>1</sup>X = don't care.

Table 9. MSOP Truth Table

IN	Switch A	Switch B
0	On	Off
1	Off	On

TYPICAL PERFORMANCE CHARACTERISTICS

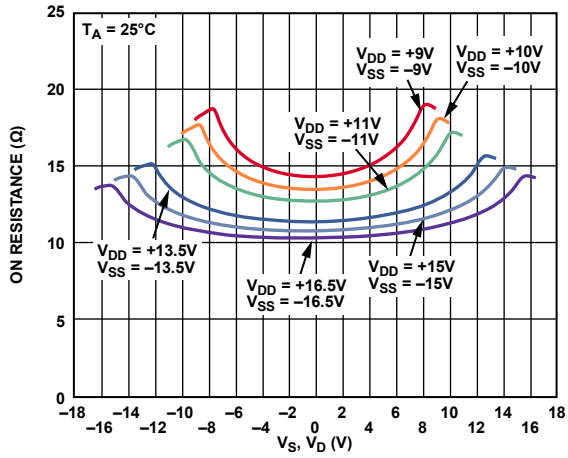


Figure 5. On Resistance as a Function of  $V_S, V_D$  Dual Supply

11370-003

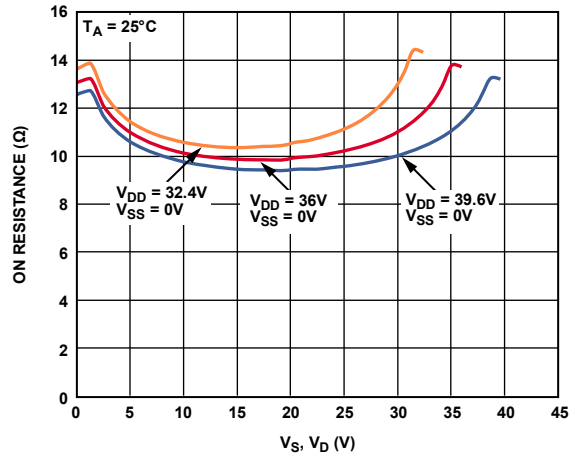


Figure 8. On Resistance as a Function of  $V_S, V_D$  (Single Supply)

11370-006

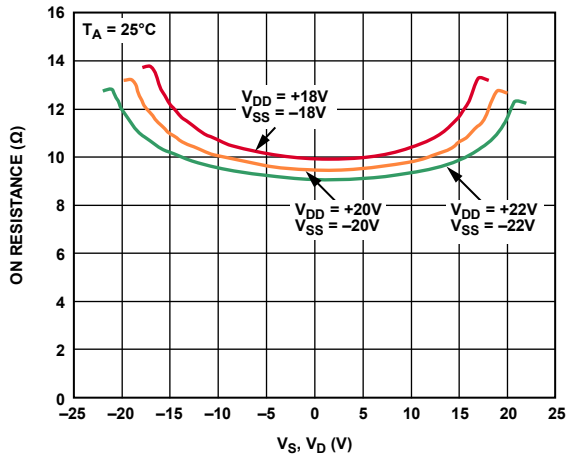


Figure 6. On Resistance as a Function of  $V_S, V_D$  Dual Supply

11370-004

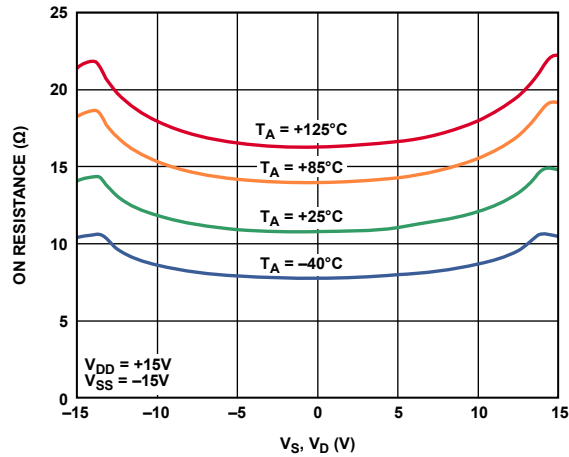


Figure 9. On Resistance as a Function of  $V_S (V_D)$  for Different Temperatures,  $\pm 15$  V Dual Supply

11370-007

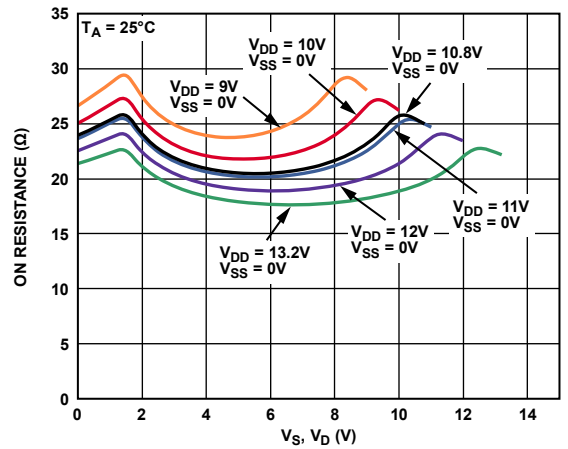


Figure 7. On Resistance as a Function of  $V_S, V_D$  (Single Supply)

11370-005

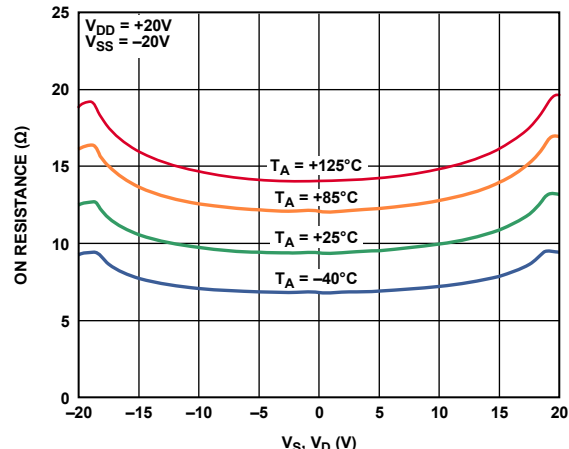


Figure 10. On Resistance as a Function of  $V_S (V_D)$  for Different Temperatures,  $\pm 20$  V Dual Supply

11370-008

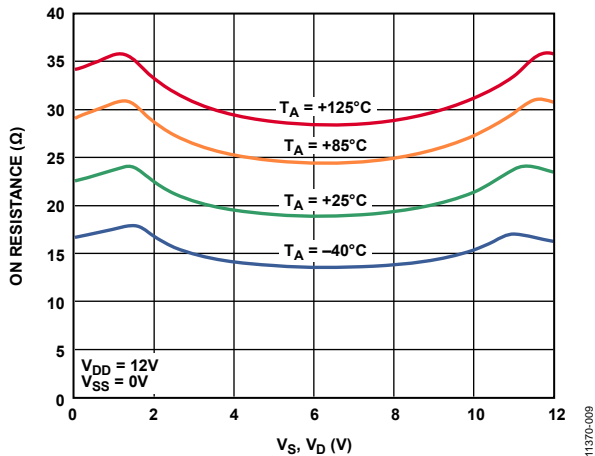


Figure 11. On Resistance as a Function of  $V_S$  ( $V_D$ ) for Different Temperatures, 12 V Single Supply

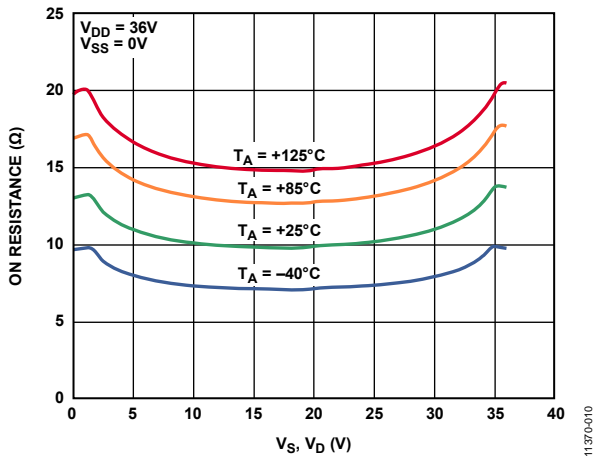


Figure 12. On Resistance as a Function of  $V_S$  ( $V_D$ ) for Different Temperatures, 36 V Single Supply

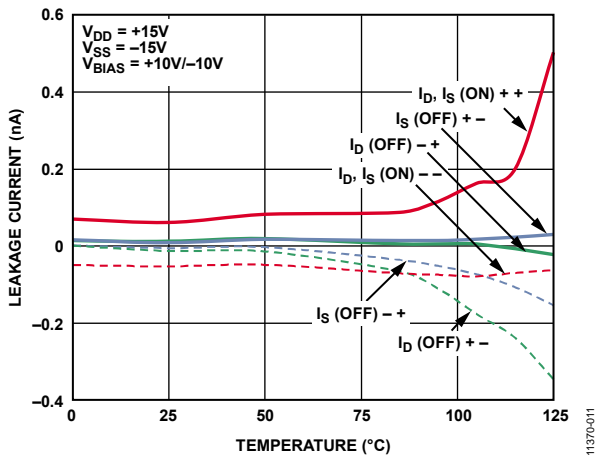


Figure 13. Leakage Currents as a Function of Temperature,  $\pm 15$  V Dual Supply

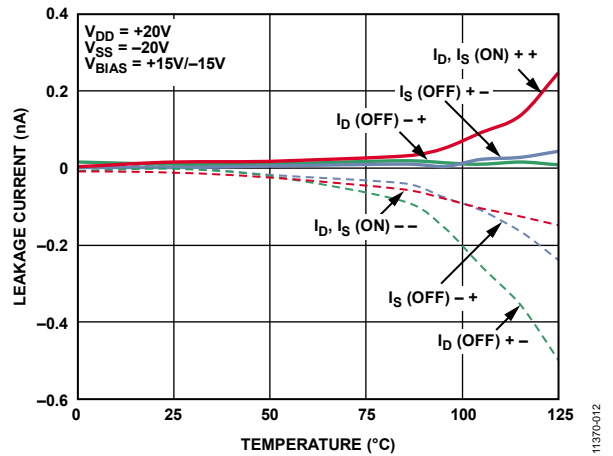


Figure 14. Leakage Currents as a Function of Temperature,  $\pm 20$  V Dual Supply

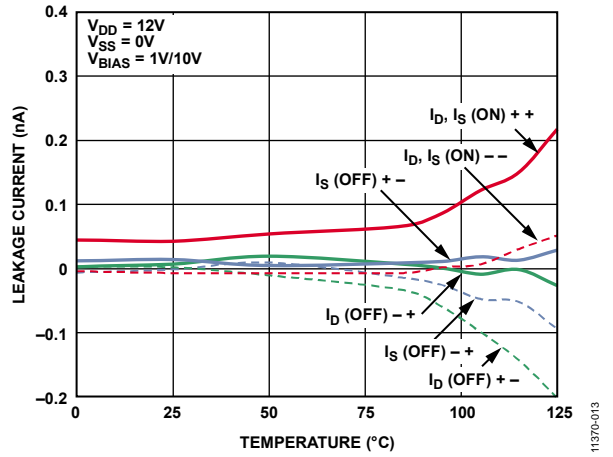


Figure 15. Leakage Currents as a Function of Temperature, 12 V Single Supply

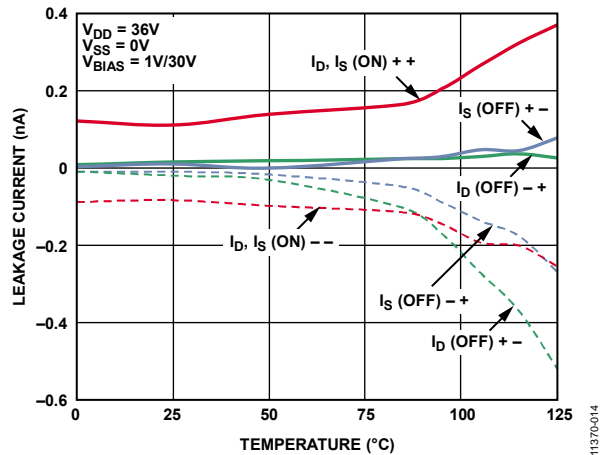


Figure 16. Leakage Currents as a Function of Temperature, 36 V Single Supply

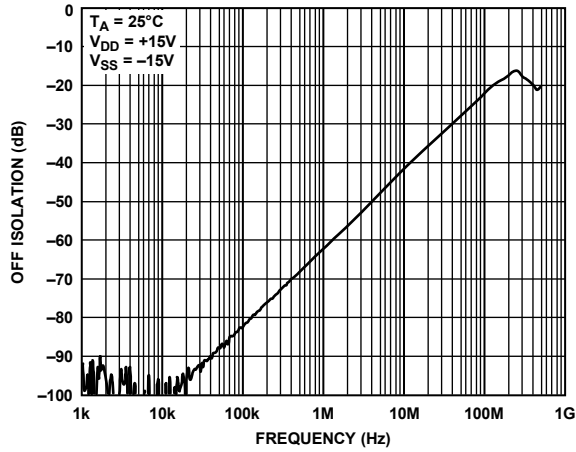


Figure 17. Off Isolation vs. Frequency

11370-015

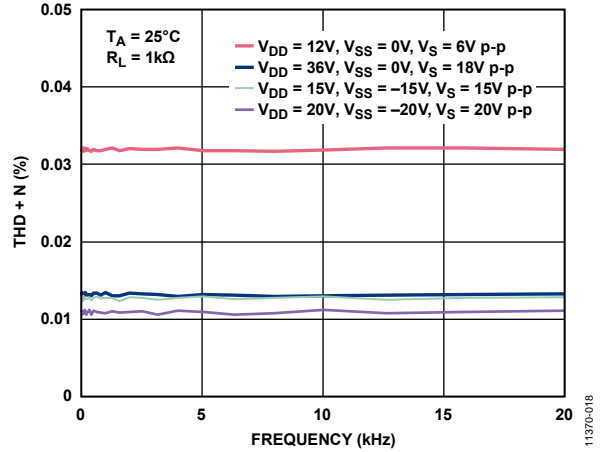


Figure 20. THD + N vs. Frequency

11370-018

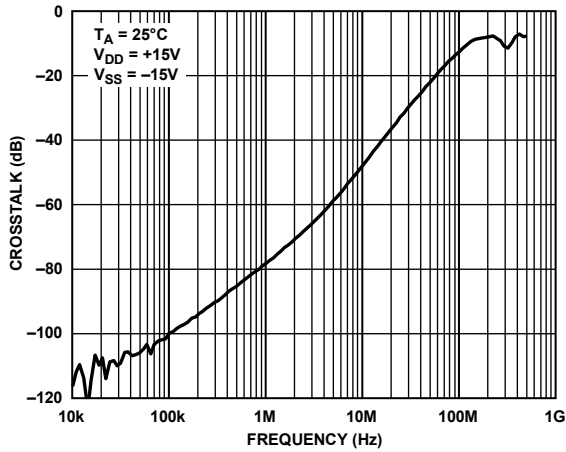


Figure 18. Crosstalk vs. Frequency

11370-016

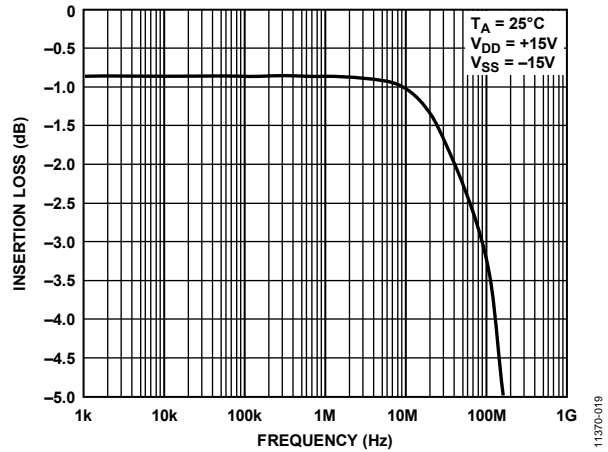


Figure 21. Bandwidth

11370-019

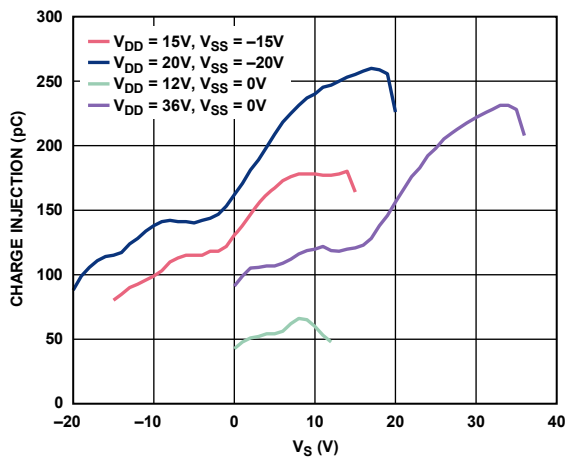


Figure 19. Charge Injection vs. Source Voltage

11370-017

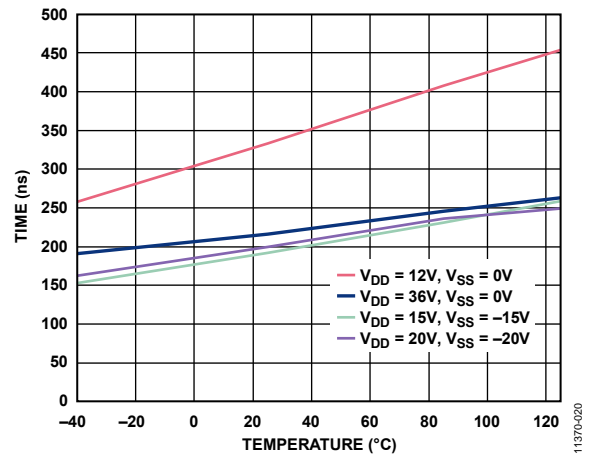


Figure 22.  $t_{\text{TRANSITION}}$  Times vs. Temperature

11370-020

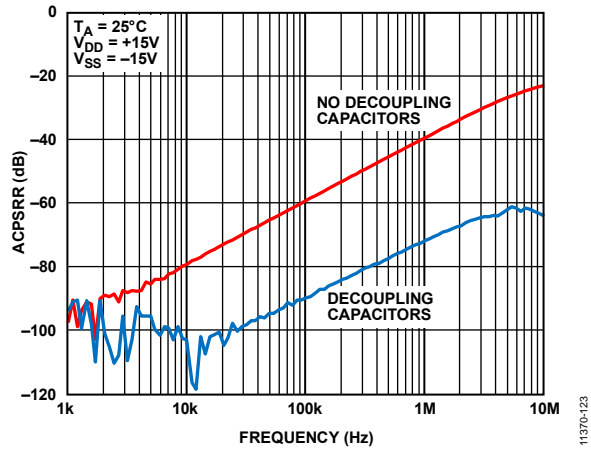


Figure 23. ACPSRR vs. Frequency

11370-123

TEST CIRCUITS

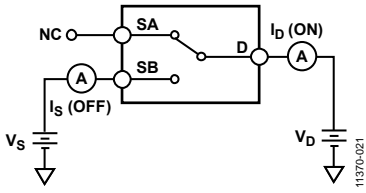


Figure 24. Channel On and Source Off Leakage (MSOP Only)

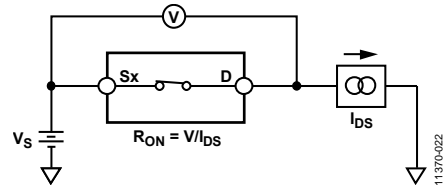


Figure 27. On Resistance

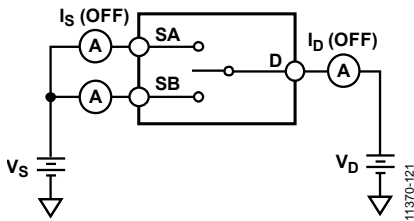
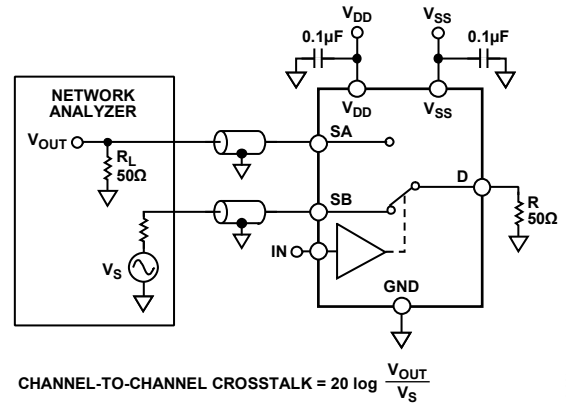


Figure 25. Off Leakage (LFCSP Only)



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

Figure 28. Channel-to-Channel Crosstalk

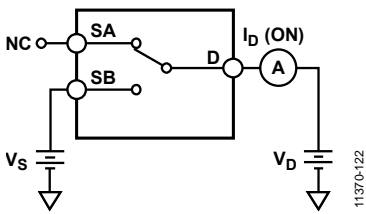
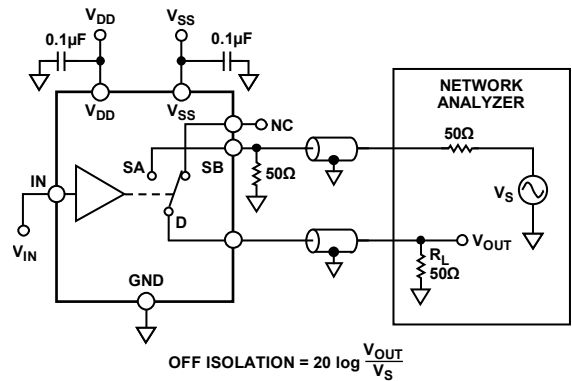


Figure 26. On Leakage (LFCSP Only)



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

Figure 29. Off Isolation

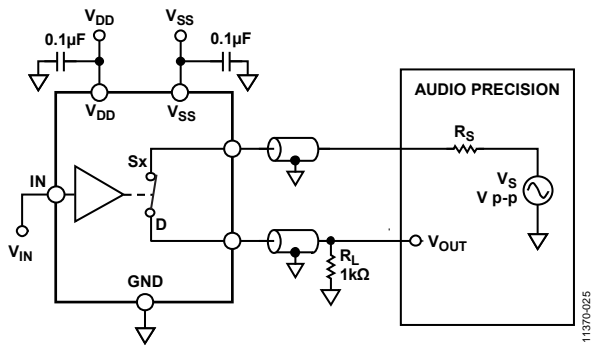


Figure 30. THD + Noise

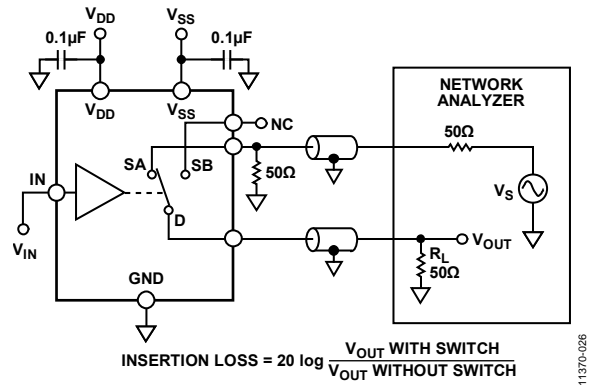
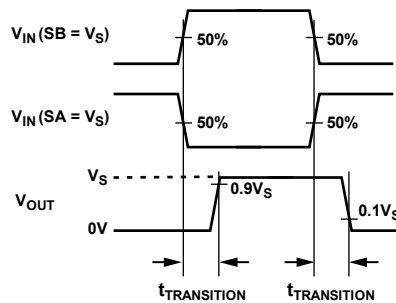
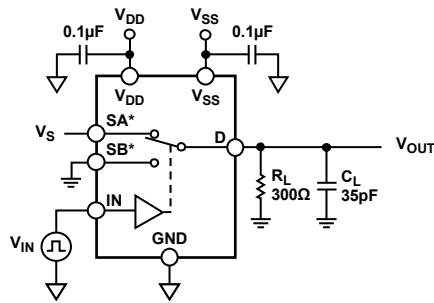


Figure 31. Bandwidth



\*ALTERNATIVELY, SB CAN BE CONNECTED TO VS WITH SA CONNECTED TO GROUND.

Figure 32. Transition Time,  $t_{TRANSITION}$

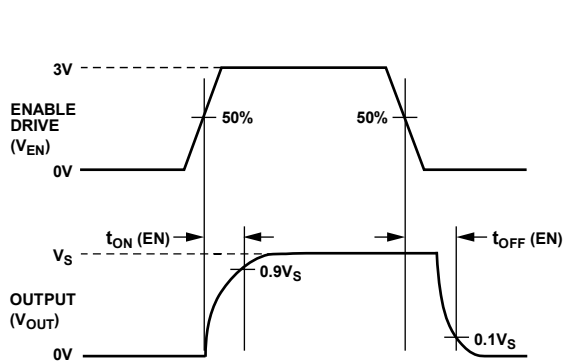
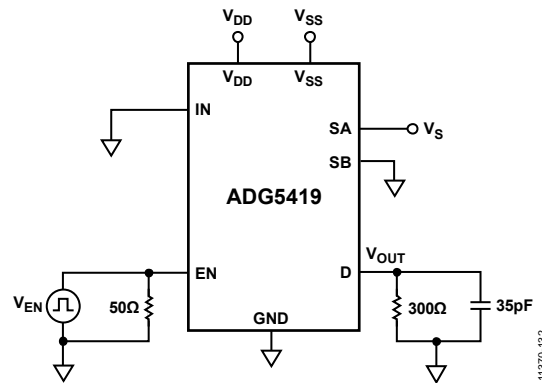


Figure 33. Enable Delay,  $t_{ON}(EN)$ ,  $t_{OFF}(EN)$  (LFCSP Only)



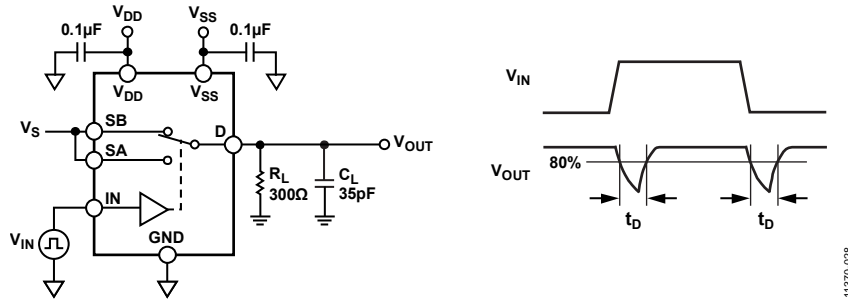


Figure 34. Break-Before-Make Delay,  $t_D$

11370-028

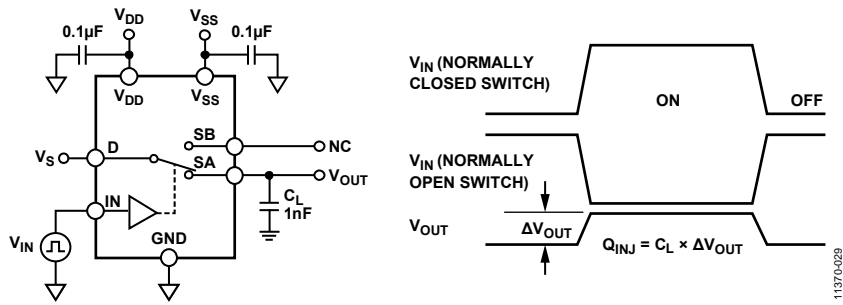


Figure 35. Charge Injection

11370-029



## TERMINOLOGY

### $I_{DD}$

$I_{DD}$  represents the positive supply current.

### $I_{SS}$

$I_{SS}$  represents the negative supply current.

### $V_D, V_S$

$V_D$  and  $V_S$  represent the analog voltage on Terminal D and Terminal S, respectively.

### $R_{ON}$

$R_{ON}$  is the ohmic resistance between Terminal D and Terminal S.

### $\Delta R_{ON}$

$\Delta R_{ON}$  represents the difference between the  $R_{ON}$  of any two channels.

### $R_{FLAT (ON)}$

The difference between the maximum and minimum value of on resistance as measured over the specified analog signal range is represented by  $R_{FLAT (ON)}$ .

### $I_S (Off)$

$I_S (Off)$  is the source leakage current with the switch off.

### $I_D (Off)$

$I_D (Off)$  is the drain leakage current with the switch off.

### $I_D (On), I_S (On)$

$I_D (On)$  and  $I_S (On)$  represent the channel leakage currents with the switch on.

### $V_{INL}$

$V_{INL}$  is the maximum input voltage for Logic 0.

### $V_{INH}$

$V_{INH}$  is the minimum input voltage for Logic 1.

### $I_{INL}, I_{INH}$

$I_{INL}$  and  $I_{INH}$  represent the low and high input currents of the digital inputs.

### $C_D (Off)$

$C_D (Off)$  represents the off switch drain capacitance, which is measured with reference to ground.

### $C_S (Off)$

$C_S (Off)$  represents the off switch source capacitance, which is measured with reference to ground.

### $C_D (On), C_S (On)$

$C_D (On)$  and  $C_S (On)$  represent on switch capacitances, which are measured with reference to ground.

### $C_{IN}$

$C_{IN}$  represents digital input capacitance.

### $t_{ON (EN)}$

$t_{ON}$  represents the delay time between the 50% and 90% points of the digital input and switch on condition. See Figure 33.

### $t_{OFF (EN)}$

$t_{OFF}$  represents the delay time between the 50% and 90% points of the digital input and switch off condition. See Figure 33.

### $t_{TRANSITION}$

$t_{TRANSITION}$  represents the delay time between the 50% and 90% points of the digital inputs and the switch on condition when switching from one address state to another.

### $t_D$

$t_D$  represents the off time measured between the 80% point of both switches when switching from one address state to another.

### Off Isolation

Off isolation is a measure of unwanted signal coupling through an off channel.

### Charge Injection

Charge injection is a measure of the glitch impulse transferred from the digital input to the analog output during switching.

### Crosstalk

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

### Bandwidth

Bandwidth is the frequency at which the output is attenuated by 3 dB, from its dc level.

### Total Harmonic Distortion + Noise (THD + N)

THD + N is the ratio of the harmonic amplitude plus noise of the signal to the fundamental.

### AC Power Supply Rejection Ratio (ACPSRR)

ACPSRR measures the ability of a device to avoid coupling noise and spurious signals that appear on the supply voltage pin to the output of the switch. The dc voltage on the device is modulated by a sine wave of 0.62 V p-p. The ratio of the amplitude of signal on the output to the amplitude of the modulation is the ACPSRR. See Figure 23.

## APPLICATIONS INFORMATION

The [ADG54xx](#) family of switches and multiplexers provide a robust solution for instrumentation, industrial, aerospace, and other harsh environments that are prone to latch-up, which is an undesirable high current state that can lead to device failure and persists until the power supply is turned off. The [ADG5419](#) high voltage switch allows single-supply operation from 9 V to 40 V and dual-supply operation from  $\pm 9$  V to  $\pm 22$  V. The [ADG5419](#) (as well as other select devices within this family) achieves an 8 kV human body model ESD rating, which provides a robust solution, eliminating the need for separate protection circuitry designs in some applications.

### TRENCH ISOLATION

In the [ADG5419](#), an insulating oxide layer (trench) is placed between the NMOS and the PMOS transistors of each CMOS switch. Parasitic junctions, which occur between the transistors in junction-isolated switches, are eliminated, and the result is a completely latch-up immune switch.

In junction isolation, the N and P wells of the PMOS and NMOS transistors form a diode that is reverse-biased under normal operation. However, during overvoltage conditions, this diode can become forward-biased. The two transistors form a silicon-controlled rectifier (SCR) type circuit, causing a significant amplification of the current that, in turn, leads to latch-up. With trench isolation, this diode is removed, and the result is a latch-up immune switch.

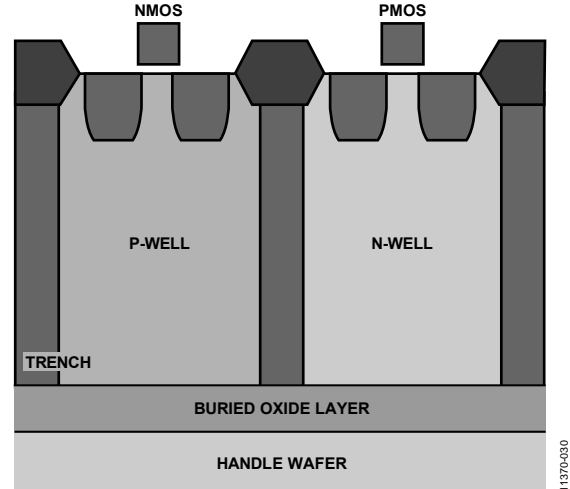


Figure 36. Trench Isolation

OUTLINE DIMENSIONS

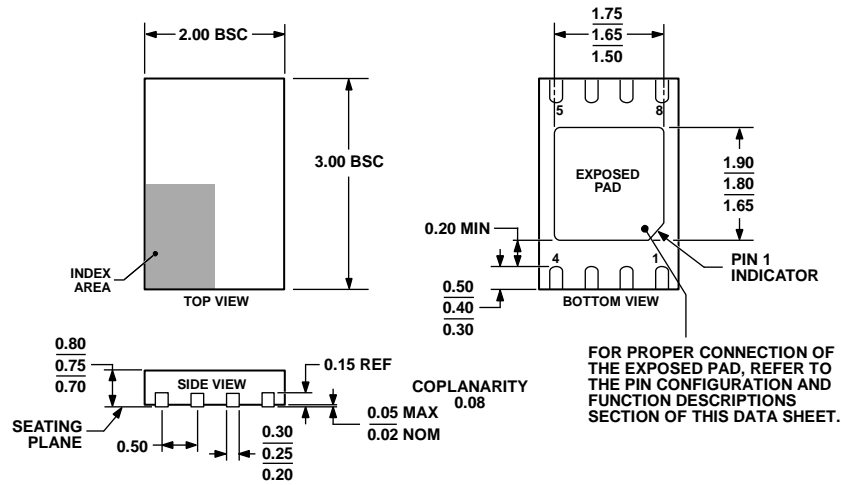
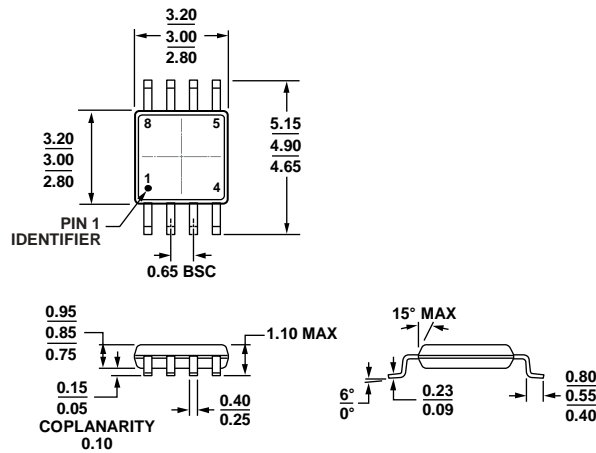


Figure 37. 8-Lead Lead Frame Chip Scale Package [LFCSP\_WD]  
2 mm × 3 mm Body, Very Very Thin, Dual Lead  
(CP-8-4)

Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-187-AA  
Figure 38. 8-Lead Mini Small Outline Package [MSOP]  
(RM-8)

Dimensions shown in millimeters

ORDERING GUIDE

Model <sup>1</sup>	Temperature Range	Package Description	Package Option	Branding
ADG5419BCPZ-RL7	-40°C to +125°C	8-Lead Lead Frame Chip Scale Package [LFCSP_WD]	CP-8-4	BL
ADG5419BRMZ	-40°C to +125°C	8-Lead Mini Small Outline Package [MSOP]	RM-8	S48
ADG5419BRMZ-RL7	-40°C to +125°C	8-Lead Mini Small Outline Package [MSOP]	RM-8	S48

<sup>1</sup> Z = RoHS Compliant Part.

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