

### FEATURES

- Latch-up proof
- 4.5 pF off source capacitance
- 10 pF off drain capacitance
- 0.6 pC charge injection
- Low on resistance: 160  $\Omega$  typical
- $\pm 9$  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
- Human body model (HBM) ESD rating
  - 4 kV I/O port to supplies
  - 1 kV I/O port to I/O port
  - 4 kV all other pins

### APPLICATIONS

- Automatic test equipment
- Data acquisition
- Instrumentation
- Avionics
- Audio and video switching
- Communication systems

### GENERAL DESCRIPTION

The [ADG5233](#) and [ADG5234](#) are monolithic industrial CMOS analog switches comprising three independently selectable single-pole, double throw (SPDT) switches and four independently selectable SPDT switches, respectively.

All channels exhibit break-before-make switching action that prevents momentary shorting when switching channels. An  $\overline{EN}$  input on the [ADG5233](#) (LFCSP and TSSOP packages) is used to enable or disable the device. When disabled, all channels are switched off.

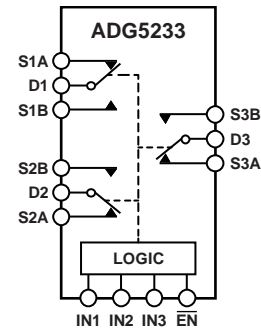
The ultralow capacitance and charge injection of these switches make them ideal solutions for data acquisition and sample-and-hold applications, where low glitch and fast settling are required. Fast switching speed coupled with high signal bandwidth make these devices suitable for video signal switching.

Rev. B

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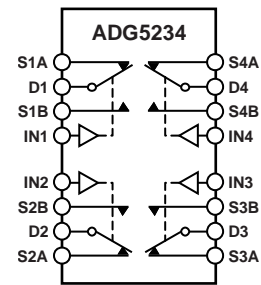
### FUNCTIONAL BLOCK DIAGRAMS



SWITCHES SHOWN FOR  
A 1 INPUT LOGIC.

09819-001

Figure 1. [ADG5233](#) TSSOP and LFCSP\_WQ



SWITCHES SHOWN FOR  
A 1 INPUT LOGIC.

09819-002

Figure 2. [ADG5234](#) TSSOP and LFCSP\_WQ

### PRODUCT HIGHLIGHTS

1. Trench Isolation Guards Against Latch-Up.  
A dielectric trench separates the P and N channel transistors thereby preventing latch-up even under severe overvoltage conditions.
2. Ultralow Capacitance and -0.6 pC Charge Injection.
3. Dual-Supply Operation.  
For applications where the analog signal is bipolar, the [ADG5233/ADG5234](#) can be operated from dual supplies up to  $\pm 22$  V.
4. Single-Supply Operation.  
For applications where the analog signal is unipolar, the [ADG5233/ADG5234](#) 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  $V_L$  Logic Power Supply Required.

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**REVISION HISTORY**

<b>6/13—Rev. A to Rev. B</b>	
Added 20-Lead LFCSP.....	Universal
Updated Outline Dimensions .....	21
Changes to Ordering Guide .....	22
<b>3/12—Rev. 0 to Rev. A</b>	
Added 16-Lead LFCSP.....	Universal
Changes to Ordering Guide .....	22
<b>7/11—Revision 0: Initial Version</b>	

# SPECIFICATIONS

## ±15 V DUAL SUPPLY

$V_{DD} = +15\text{ V} \pm 10\%$ ,  $V_{SS} = -15\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ , 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, $R_{ON}$	160			$\Omega$ typ	$V_S = \pm 10\text{ V}$ , $I_S = -1\text{ mA}$ ; see Figure 27
	200	250	280	$\Omega$ max	$V_{DD} = +13.5\text{ V}$ , $V_{SS} = -13.5\text{ V}$
On-Resistance Match Between Channels, $\Delta R_{ON}$	3.5			$\Omega$ typ	$V_S = \pm 10\text{ V}$ , $I_S = -1\text{ mA}$
	8	9	10	$\Omega$ max	
On-Resistance Flatness, $R_{FLAT(ON)}$	38			$\Omega$ typ	$V_S = \pm 10\text{ V}$ , $I_S = -1\text{ mA}$
	50	65	70	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_S$ (Off)	$\pm 0.02$			nA typ	$V_{DD} = +16.5\text{ V}$ , $V_{SS} = -16.5\text{ V}$
	$\pm 0.1$	$\pm 0.2$	$\pm 0.4$	nA max	$V_S = \pm 10\text{ V}$ , $V_D = \mp 10\text{ V}$ ; see Figure 29
Drain Off Leakage, $I_D$ (Off)	$\pm 0.02$			nA typ	$V_S = \pm 10\text{ V}$ , $V_D = \mp 10\text{ V}$ ; see Figure 29
	$\pm 0.1$	$\pm 0.2$	$\pm 0.4$	nA max	
Channel On Leakage, $I_D$ (On), $I_S$ (On)	$\pm 0.08$			nA typ	$V_S = V_D = \pm 10\text{ V}$ ; see Figure 26
	$\pm 0.2$	$\pm 0.3$	$\pm 0.9$	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, $C_{IN}$	3			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
Transition Time, $t_{TRANSITION}$	170			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	210	250	280	ns max	$V_S = 10\text{ V}$ ; see Figure 32
$t_{ON}(\overline{EN})$	175			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	215	255	290	ns max	$V_S = 10\text{ V}$ ; see Figure 34
$t_{OFF}(\overline{EN})$	80			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	100	115	125	ns max	$V_S = 10\text{ V}$ ; see Figure 34
Break-Before-Make Time Delay, $t_D$	60			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
			30	ns min	$V_{S1} = V_{S2} = 10\text{ V}$ ; see Figure 33
Charge Injection, $Q_{INJ}$	-0.6			pC typ	$V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 35
Off Isolation	-75			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 30
Channel-to-Channel Crosstalk	-80			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 28
-3 dB Bandwidth	205			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 31
Insertion Loss	-6.3			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 31
$C_S$ (Off)	4.5			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (Off)	10			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (On), $C_S$ (On)	15			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$

Parameter	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
<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 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, $R_{ON}$	140			$\Omega$ typ	$V_S = \pm 15\text{ V}$ , $I_S = -1\text{ mA}$ ; see Figure 27
	160	200	230	$\Omega$ max	$V_{DD} = +18\text{ V}$ , $V_{SS} = -18\text{ V}$
On-Resistance Match Between Channels, $\Delta R_{ON}$	3.5			$\Omega$ typ	$V_S = \pm 15\text{ V}$ , $I_S = -1\text{ mA}$
	8	9	10	$\Omega$ max	
On-Resistance Flatness, $R_{FLAT(ON)}$	33			$\Omega$ typ	$V_S = \pm 15\text{ V}$ , $I_S = -1\text{ mA}$
	45	55	60	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_S$ (Off)	$\pm 0.02$			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 29
	$\pm 0.1$	$\pm 0.2$	$\pm 0.4$	nA max	
Drain Off Leakage, $I_D$ (Off)	$\pm 0.02$			nA typ	$V_S = \pm 15\text{ V}$ , $V_D = \mp 15\text{ V}$ ; see Figure 29
	$\pm 0.1$	$\pm 0.2$	$\pm 0.4$	nA max	
Channel On Leakage, $I_D$ (On), $I_S$ (On)	$\pm 0.08$			nA typ	$V_S = V_D = \pm 15\text{ V}$ ; see Figure 26
	$\pm 0.2$	$\pm 0.3$	$\pm 0.9$	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, $C_{IN}$	3			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
Transition Time, $t_{TRANSITION}$	170			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	200	235	260	ns max	$V_S = 10\text{ V}$ ; see Figure 32
$t_{ON}(\overline{EN})$	165			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	200	240	265	ns max	$V_S = 10\text{ V}$ ; see Figure 34
$t_{OFF}(\overline{EN})$	80			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	95	105	115	ns max	$V_S = 10\text{ V}$ ; see Figure 34
Break-Before-Make Time Delay, $t_D$	50			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
			30	ns min	$V_{S1} = V_{S2} = 10\text{ V}$ ; see Figure 33
Charge Injection, $Q_{INJ}$	0			pC typ	$V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 35
Off Isolation	-75			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 30
Channel-to-Channel Crosstalk	-80			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 28
-3 dB Bandwidth	210			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 31
Insertion Loss	-5.5			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 31

Parameter	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
C <sub>S</sub> (Off)	4.5			pF typ	V <sub>S</sub> = 0 V, f = 1 MHz
C <sub>D</sub> (Off)	10			pF typ	V <sub>S</sub> = 0 V, f = 1 MHz
C <sub>D</sub> (On), C <sub>S</sub> (On)	15			pF typ	V <sub>S</sub> = 0 V, f = 1 MHz
<b>POWER REQUIREMENTS</b>					
I <sub>DD</sub>	50			μA typ	V <sub>DD</sub> = +22 V, V <sub>SS</sub> = -22 V
	70		110	μA max	Digital inputs = 0 V or V <sub>DD</sub>
I <sub>SS</sub>	0.001			μA typ	Digital inputs = 0 V or V <sub>DD</sub>
			1	μA max	
V <sub>DD</sub> /V <sub>SS</sub>			±9/±22	V min/V max	GND = 0 V

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

## 12 V SINGLE SUPPLY

V<sub>DD</sub> = 12 V ± 10%, V<sub>SS</sub> = 0 V, GND = 0 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 <sub>DD</sub>	V	
On Resistance, R <sub>ON</sub>	360			Ω typ	V <sub>S</sub> = 0 V to 10 V, I <sub>S</sub> = -1 mA; see Figure 27
On-Resistance Match Between Channels, ΔR <sub>ON</sub>	500	610	700	Ω max	V <sub>DD</sub> = 10.8 V, V <sub>SS</sub> = 0 V
	5.5			Ω typ	V <sub>S</sub> = 0 V to 10 V, I <sub>S</sub> = -1 mA
On-Resistance Flatness, R <sub>FLAT(ON)</sub>	20	21	22	Ω max	
	170			Ω typ	V <sub>S</sub> = 0 V to 10 V, I <sub>S</sub> = -1 mA
	280	335	370	Ω max	
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, I <sub>S</sub> (Off)	±0.02			nA typ	V <sub>DD</sub> = 13.2 V, V <sub>SS</sub> = 0 V
Drain Off Leakage, I <sub>D</sub> (Off)	±0.1	±0.2	±0.4	nA max	V <sub>S</sub> = 1 V/10 V, V <sub>D</sub> = 10 V/1 V; see Figure 29
	±0.02			nA typ	V <sub>S</sub> = 1 V/10 V, V <sub>D</sub> = 10 V/1 V; see Figure 29
Channel On Leakage, I <sub>D</sub> (On), I <sub>S</sub> (On)	±0.1	±0.2	±0.4	nA max	
	±0.08			nA typ	V <sub>S</sub> = V <sub>D</sub> = 1 V/10 V; see Figure 26
	±0.2	±0.3	±0.9	nA max	
<b>DIGITAL INPUTS</b>					
Input High Voltage, V <sub>INH</sub>			2.0	V min	
Input Low Voltage, V <sub>INL</sub>			0.8	V max	
Input Current, I <sub>INL</sub> or I <sub>INH</sub>	0.002			μA typ	V <sub>IN</sub> = V <sub>GND</sub> or V <sub>DD</sub>
			±0.1	μA max	
Digital Input Capacitance, C <sub>IN</sub>	3			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
Transition Time, t <sub>TRANSITION</sub>	235			ns typ	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF
	295	365	410	ns max	V <sub>S</sub> = 8 V; see Figure 32
t <sub>ON</sub> ( $\overline{\text{EN}}$ )	240			ns typ	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF
	305	380	430	ns max	V <sub>S</sub> = 8 V; see Figure 34
t <sub>OFF</sub> ( $\overline{\text{EN}}$ )	70			ns typ	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF
	90	105	115	ns max	V <sub>S</sub> = 8 V; see Figure 34
Break-Before-Make Time Delay, t <sub>D</sub>	125			ns typ	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF
			65	ns min	V <sub>S1</sub> = V <sub>S2</sub> = 8 V; see Figure 33
Charge Injection, Q <sub>INJ</sub>	0			pC typ	V <sub>S</sub> = 6 V, R <sub>S</sub> = 0 Ω, C <sub>L</sub> = 1 nF; see Figure 35

Parameter	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
Off Isolation	-75			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ ; see Figure 30
Channel-to-Channel Crosstalk	-80			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ ; see Figure 28
-3 dB Bandwidth	172			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ ; see Figure 31
Insertion Loss	-8.7			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\ \text{pF}$ , $f = 1\ \text{MHz}$ ; see Figure 31
$C_S$ (Off)	5			pF typ	$V_S = 6\ \text{V}$ , $f = 1\ \text{MHz}$
$C_D$ (Off)	11			pF typ	$V_S = 6\ \text{V}$ , $f = 1\ \text{MHz}$
$C_D$ (On), $C_S$ (On)	16			pF typ	$V_S = 6\ \text{V}$ , $f = 1\ \text{MHz}$
POWER REQUIREMENTS					$V_{DD} = 13.2\ \text{V}$
$I_{DD}$	40			$\mu\text{A}$ typ	Digital inputs = 0 V or $V_{DD}$
	50		65	$\mu\text{A}$ max	
$V_{DD}$			9/40	V min/V max	$\text{GND} = 0\ \text{V}$ , $V_{SS} = 0\ \text{V}$

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

### 36 V SINGLE SUPPLY

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

Table 4.

Parameter	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
ANALOG SWITCH					
Analog Signal Range			0 V to $V_{DD}$	V	
On Resistance, $R_{ON}$	140			$\Omega$ typ	$V_S = 0\ \text{V}$ to 30 V, $I_S = -1\ \text{mA}$ ; see Figure 27
	170	215	245	$\Omega$ max	$V_{DD} = 32.4\ \text{V}$ , $V_{SS} = 0\ \text{V}$
On-Resistance Match Between Channels, $\Delta R_{ON}$	3.5			$\Omega$ typ	$V_S = 0\ \text{V}$ to 30 V, $I_S = -1\ \text{mA}$
	8	9	10	$\Omega$ max	
On-Resistance Flatness, $R_{FLAT(ON)}$	35			$\Omega$ typ	$V_S = 0\ \text{V}$ to 30 V, $I_S = -1\ \text{mA}$
	50	60	65	$\Omega$ max	
LEAKAGE CURRENTS					
Source Off Leakage, $I_S$ (Off)	$\pm 0.02$			nA typ	$V_{DD} = 39.6\ \text{V}$ , $V_{SS} = 0\ \text{V}$ $V_S = 1\ \text{V}/30\ \text{V}$ , $V_D = 30\ \text{V}/1\ \text{V}$ ; see Figure 29
	$\pm 0.1$	$\pm 0.2$	$\pm 0.4$	nA max	
Drain Off Leakage, $I_D$ (Off)	$\pm 0.02$			nA typ	$V_S = 1\ \text{V}/30\ \text{V}$ , $V_D = 30\ \text{V}/1\ \text{V}$ ; see Figure 29
	$\pm 0.1$	$\pm 0.2$	$\pm 0.4$	nA max	
Channel On Leakage, $I_D$ (On), $I_S$ (On)	$\pm 0.08$			nA typ	$V_S = V_D = 1\ \text{V}/30\ \text{V}$ ; see Figure 26
	$\pm 0.2$	$\pm 0.3$	$\pm 0.9$	nA max	
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 $I_{INH}$	0.002			$\mu\text{A}$ typ	$V_{IN} = V_{GND}$ or $V_{DD}$
			$\pm 0.1$	$\mu\text{A}$ max	
Digital Input Capacitance, $C_{IN}$	3			pF typ	
DYNAMIC CHARACTERISTICS <sup>1</sup>					
Transition Time, $t_{TRANSITION}$	205			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\ \text{pF}$
	255	275	290	ns max	$V_S = 18\ \text{V}$ ; see Figure 32
$t_{ON}(\overline{\text{EN}})$	200			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\ \text{pF}$
	240	265	290	ns max	$V_S = 18\ \text{V}$ ; see Figure 34
$t_{OFF}(\overline{\text{EN}})$	85			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\ \text{pF}$
	115	115	115	ns max	$V_S = 18\ \text{V}$ ; see Figure 34

Parameter	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
Break-Before-Make Time Delay, $t_D$	65		35	ns typ ns min	$R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ $V_{S1} = V_{S2} = 18 \text{ V}$ ; see Figure 33
Charge Injection, $Q_{INJ}$	-0.6			pC typ	$V_S = 18 \text{ V}$ , $R_S = 0 \Omega$ , $C_L = 1 \text{ nF}$ ; see Figure 35
Off Isolation	-75			dB typ	$R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ , $f = 1 \text{ MHz}$ ; see Figure 30
Channel-to-Channel Crosstalk	-80			dB typ	$R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ , $f = 1 \text{ MHz}$ ; see Figure 28
-3 dB Bandwidth	190			MHz typ	$R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ ; see Figure 31
Insertion Loss	-5.9			dB typ	$R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ , $f = 1 \text{ MHz}$ ; see Figure 31
$C_S$ (Off)	4.5			pF typ	$V_S = 18 \text{ V}$ , $f = 1 \text{ MHz}$
$C_D$ (Off)	10			pF typ	$V_S = 18 \text{ V}$ , $f = 1 \text{ MHz}$
$C_D$ (On), $C_S$ (On)	15			pF typ	$V_S = 18 \text{ V}$ , $f = 1 \text{ MHz}$
<b>POWER REQUIREMENTS</b>					$V_{DD} = 39.6 \text{ V}$
$I_{DD}$	80			$\mu\text{A}$ typ	Digital inputs = 0 V or $V_{DD}$
	100		130	$\mu\text{A}$ max	
$V_{DD}$			9/40	V min/V max	GND = 0 V, $V_{SS} = 0 \text{ V}$

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

## CONTINUOUS CURRENT PER CHANNEL, Sx OR Dx

Table 5. ADG5233

Parameter	25°C	85°C	125°C	Unit
CONTINUOUS CURRENT, Sx OR Dx				
$V_{DD} = +15\text{ V}, V_{SS} = -15\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	24	16	11	mA maximum
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	42	26.5	15	mA maximum
$V_{DD} = +20\text{ V}, V_{SS} = -20\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	26	17	11	mA maximum
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	46	28	15	mA maximum
$V_{DD} = 12\text{ V}, V_{SS} = 0\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	17	12	7.7	mA maximum
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	24	17	11	mA maximum
$V_{DD} = 36\text{ V}, V_{SS} = 0\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	25	17	11	mA maximum
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	45	28	15	mA maximum

Table 6. ADG5234

Parameter	25°C	85°C	125°C	Unit
CONTINUOUS CURRENT, Sx OR Dx				
$V_{DD} = +15\text{ V}, V_{SS} = -15\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	21	15	10	mA maximum
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	38	24	14	mA maximum
$V_{DD} = +20\text{ V}, V_{SS} = -20\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	22	15	10	mA maximum
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	41	26	15	mA maximum
$V_{DD} = 12\text{ V}, V_{SS} = 0\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	15	11	7	mA maximum
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	22	16	11	mA maximum
$V_{DD} = 36\text{ V}, V_{SS} = 0\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	22	15	10	mA maximum
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	40	26	15	mA maximum

## ABSOLUTE MAXIMUM RATINGS

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

Table 7.

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 Dx Pins ADG5233 ADG5234	76 mA (pulsed at 1 ms, 10% duty cycle maximum) 67 mA (pulsed at 1 ms, 10% duty cycle maximum)
Continuous Current, Sx or Dx <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, $\theta_{JA}$	
16-Lead TSSOP (4-Layer Board)	112.6°C/W
20-Lead TSSOP (4-Layer Board)	143°C/W
16-Lead LFCSP (4-Layer Board)	30.4°C/W
20-Lead LFCSP (4-Layer Board)	30.4°C/W
Reflow Soldering Peak Temperature, Pb Free	260(+0/-5)°C
Human Body Model (HBM) ESD	
I/O Port to Supplies	4 kV
I/O Port to I/O Port	1 kV
All Other Pins	4 kV

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

<sup>2</sup> See Table 5 and Table 6.

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 indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Only one absolute maximum rating can be applied at any one time.

### 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

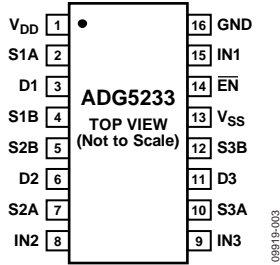


Figure 3. ADG5233 TSSOP Pin Configuration

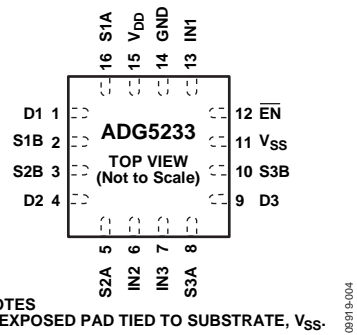


Figure 4. ADG5233 LFCSP\_WQ Pin Configuration

Table 8. ADG5233 Pin Function Descriptions

Pin No.		Mnemonic	Description
TSSOP	LFCSP_WQ		
1	15	V <sub>DD</sub>	Most Positive Power Supply Potential.
2	16	S1A	Source Terminal 1A. This pin can be an input or an output.
3	1	D1	Drain Terminal 1. This pin can be an input or an output.
4	2	S1B	Source Terminal 1B. This pin can be an input or an output.
5	3	S2B	Source Terminal 2B. This pin can be an input or an output.
6	4	D2	Drain Terminal 2. This pin can be an input or an output.
7	5	S2A	Source Terminal 2A. This pin can be an input or an output.
8	6	IN2	Logic Control Input 2.
9	7	IN3	Logic Control Input 3.
10	8	S3A	Source Terminal 3A. This pin can be an input or an output.
11	9	D3	Drain Terminal 3. This pin can be an input or an output.
12	10	S3B	Source Terminal 3B. This pin can be an input or an output.
13	11	V <sub>SS</sub>	Most Negative Power Supply Potential. In single-supply applications, this pin can be connected to ground.
14	12	$\overline{\text{EN}}$	Active Low Digital Input. When high, the device is disabled and all switches are off. When low, IN <sub>x</sub> logic inputs determine the on switches.
15	13	IN1	Logic Control Input 1.
16	14	GND	Ground (0 V) Reference.
	EP	Exposed Pad	The exposed pad is connected internally. For increased reliability of the solder joints and maximum thermal capability, it is recommended that the pad be soldered to the substrate, V <sub>SS</sub> .

Table 9. ADG5233 Truth Table

EN	IN <sub>x</sub>	S <sub>x</sub> A	S <sub>x</sub> B
1	X <sup>1</sup>	Off	Off
0	0	Off	On
0	1	On	Off

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

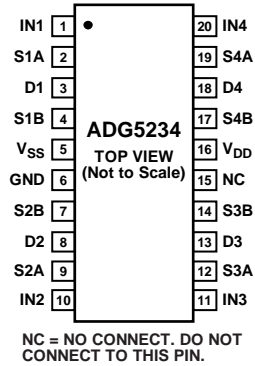
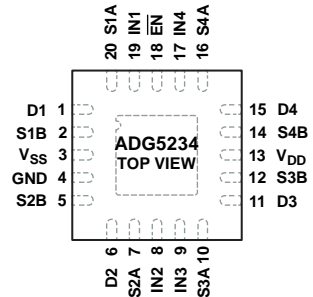


Figure 5. ADG5234 TSSOP Pin Configuration



NOTES  
1. EXPOSED PAD TIED TO SUBSTRATE, V<sub>SS</sub>.

Figure 6. ADG5234 LFCSP\_WQ Pin Configuration

Table 10. ADG5234 Pin Function Descriptions

Pin No.		Mnemonic	Description
TSSOP	LFCSP_WQ		
1	19	IN1	Logic Control Input 1.
2	20	S1A	Source Terminal 1A. This pin can be an input or an output.
3	1	D1	Drain Terminal 1. This pin can be an input or an output.
4	2	S1B	Source Terminal 1B. This pin can be an input or an output.
5	3	V <sub>SS</sub>	Most Negative Power Supply Potential. In single-supply applications, this pin can be connected to ground.
6	4	GND	Ground (0 V) Reference.
7	5	S2B	Source Terminal 2B. This pin can be an input or an output.
8	6	D2	Drain Terminal 2. This pin can be an input or an output.
9	7	S2A	Source Terminal 2A. This pin can be an input or an output.
10	8	IN2	Logic Control Input 2.
11	9	IN3	Logic Control Input 3.
12	10	S3A	Source Terminal 3A. This pin can be an input or an output.
13	11	D3	Drain Terminal 3. This pin can be an input or an output.
14	12	S3B	Source Terminal 3B. This pin can be an input or an output.
15	N/A	NC	No Connect. This pin is open.
16	13	V <sub>DD</sub>	Most Positive Power Supply Potential.
17	14	S4B	Source Terminal 4B. This pin can be an input or an output.
18	15	D4	Drain Terminal 4. This pin can be an input or an output.
19	16	S4A	Source Terminal 4A. This pin can be an input or an output.
20	17	IN4	Logic Control Input 4.
N/A	18	EN	Active Low Digital Input. When high, the device is disabled and all switches are off. When low, INx logic inputs determine the on switches.
N/A	21	EP	Exposed Pad. The exposed pad is connected internally. For increased reliability of the solder joints and maximum thermal capability, it is recommended that the pad be soldered to the substrate, V <sub>SS</sub> .

Table 11. ADG5234 Truth Table

INx	SxA	SxB
0	Off	On
1	On	Off

TYPICAL PERFORMANCE CHARACTERISTICS

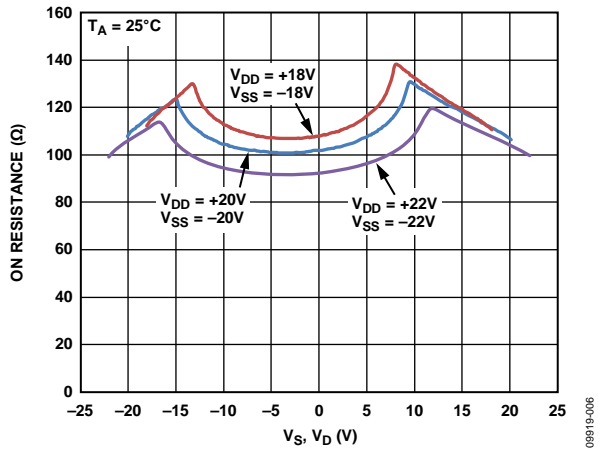


Figure 7. On Resistance as a Function of  $V_S, V_D$  ( $\pm 20$  V Dual Supply)

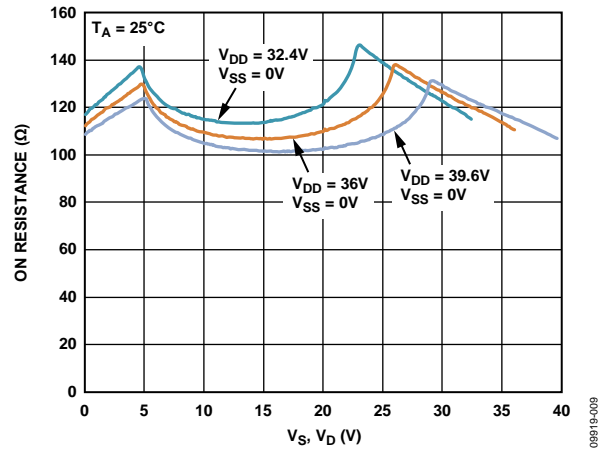


Figure 10. On Resistance as a Function of  $V_S, V_D$  (36 V Single Supply)

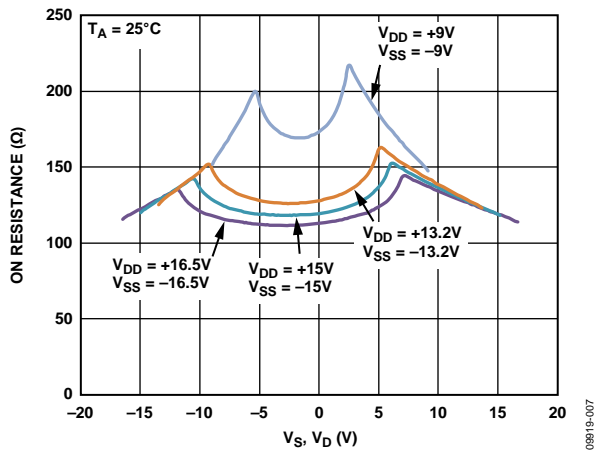


Figure 8. On Resistance as a Function of  $V_S, V_D$  ( $\pm 15$  V Dual Supply)

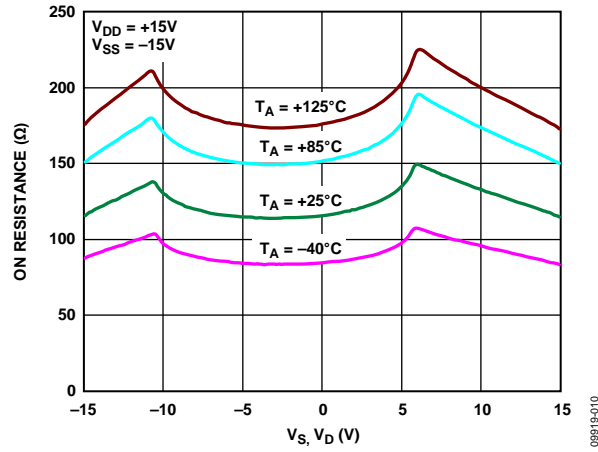


Figure 11. On Resistance as a Function of  $V_S$  ( $V_D$ ) for Different Temperatures,  $\pm 15$  V Dual Supply

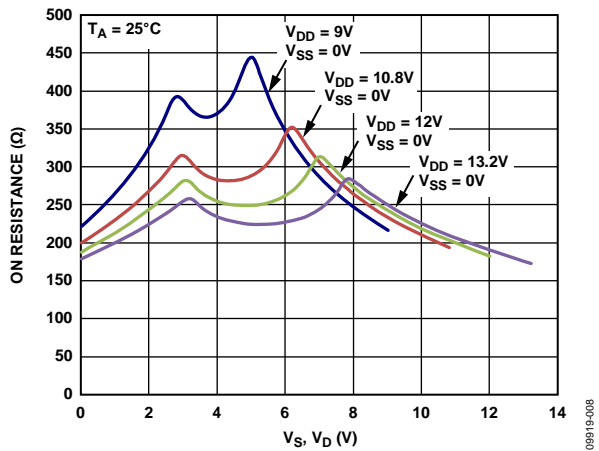


Figure 9. On Resistance as a Function of  $V_S, V_D$  (12 V Single Supply)

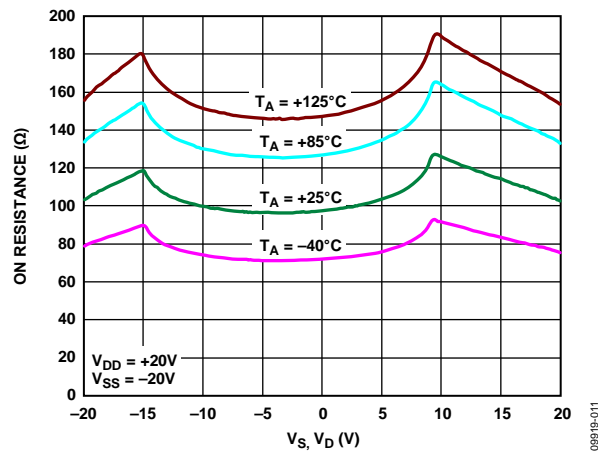


Figure 12. On Resistance as a Function of  $V_S$  ( $V_D$ ) for Different Temperatures,  $\pm 20$  V Dual Supply

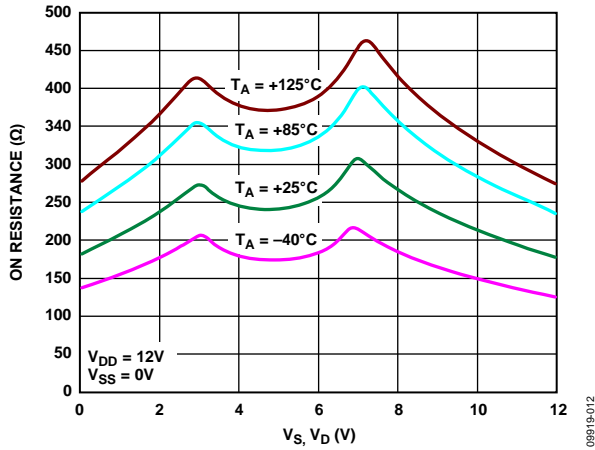


Figure 13. On Resistance as a Function of  $V_S$  ( $V_D$ ) for Different Temperatures, 12 V Single Supply

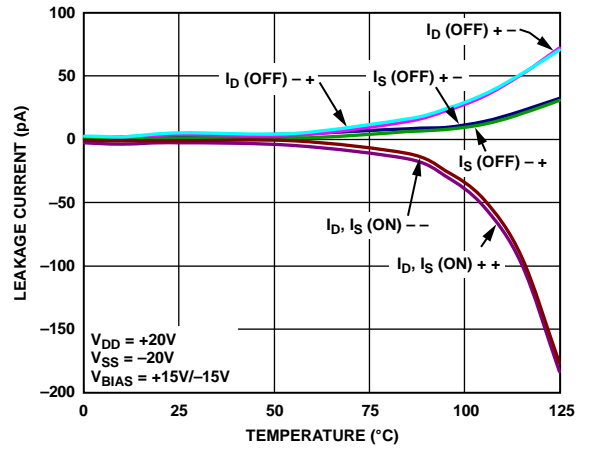


Figure 16. Leakage Currents as a Function of Temperature,  $\pm 20$  V Dual Supply

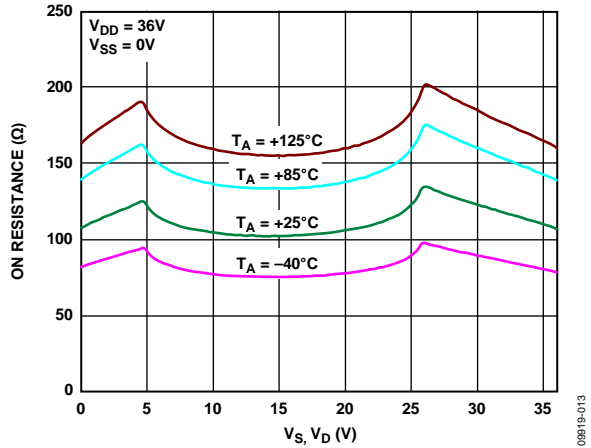


Figure 14. On Resistance as a Function of  $V_S$  ( $V_D$ ) for Different Temperatures, 36 V Single Supply

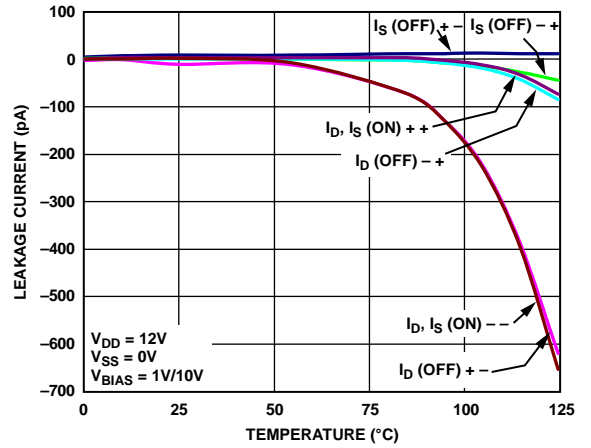


Figure 17. Leakage Currents as a Function of Temperature, 12 V Single Supply

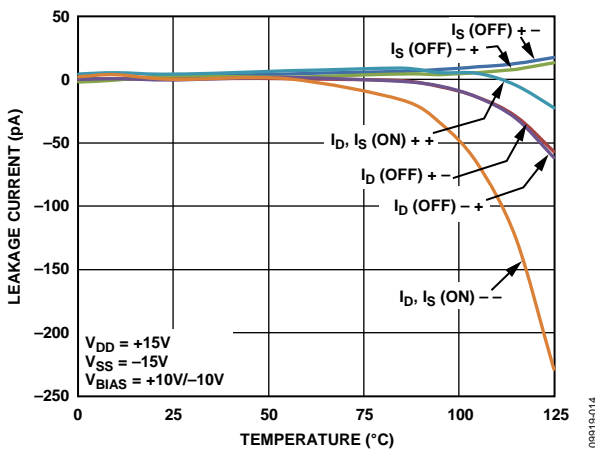


Figure 15. Leakage Currents as a Function of Temperature,  $\pm 15$  V Dual Supply

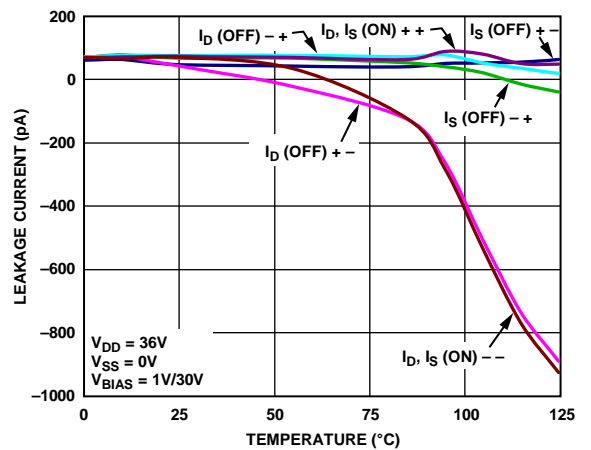


Figure 18. Leakage Currents as a Function of Temperature, 36 V Single Supply

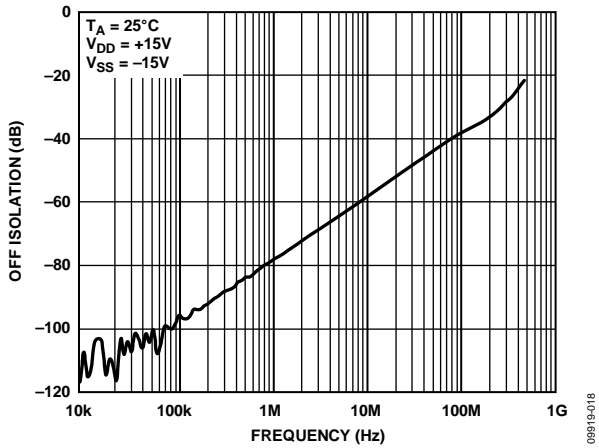


Figure 19. Off Isolation vs. Frequency, ±15 V Dual Supply

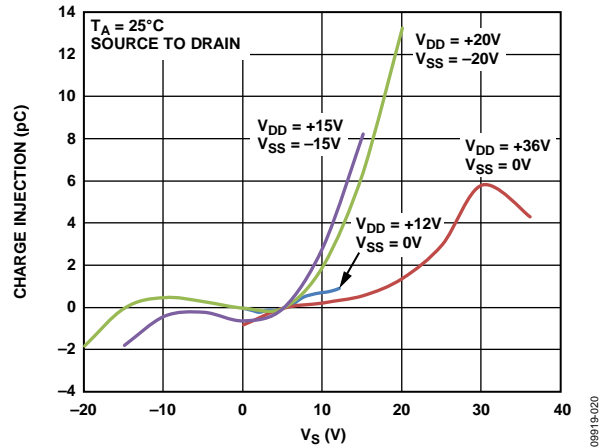


Figure 21. Charge Injection vs. Source Voltage, Source to Drain

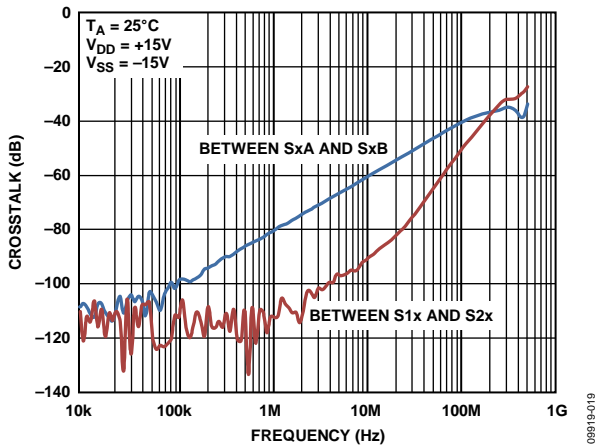


Figure 20. Crosstalk vs. Frequency, ±15 V Dual Supply

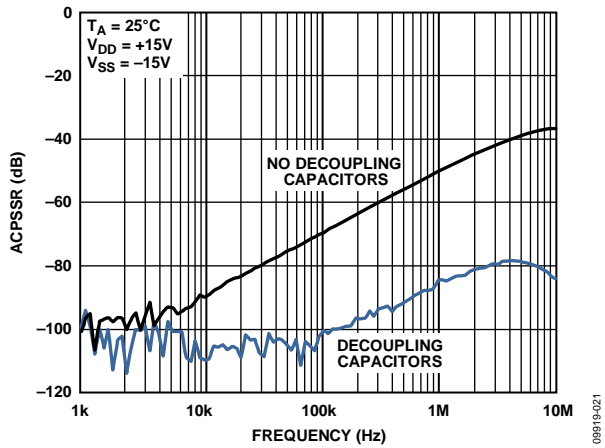


Figure 22. ACPSRR vs. Frequency, ±15 V Dual Supply

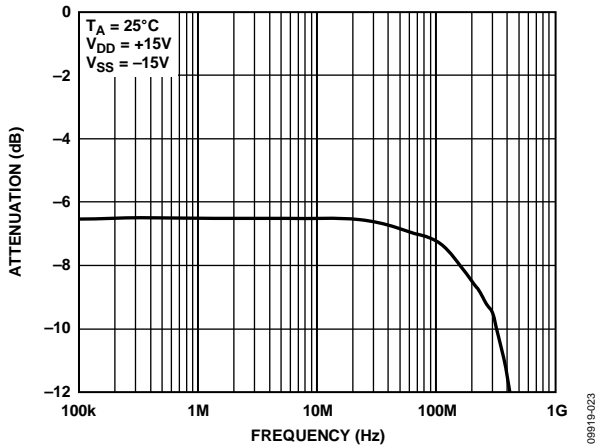


Figure 23. Bandwidth

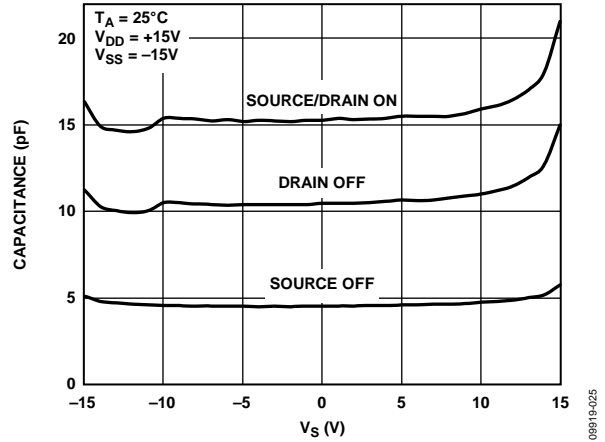


Figure 25. Capacitance vs. Source Voltage,  $\pm 15\text{ V}$  Dual Supply

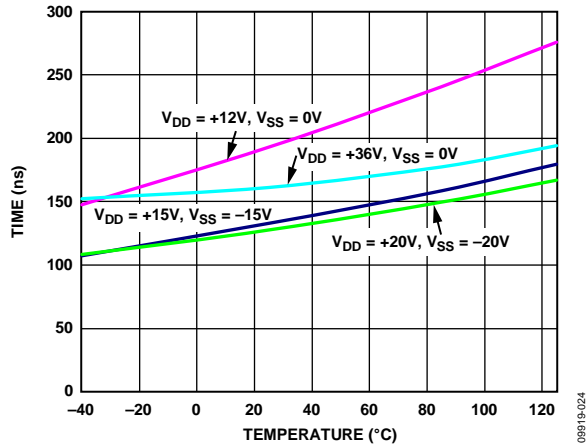


Figure 24.  $t_{\text{TRANSITION}}$  Times vs. Temperature

TEST CIRCUITS

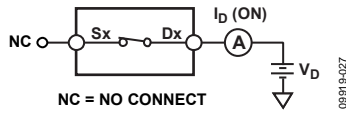


Figure 26. On Leakage

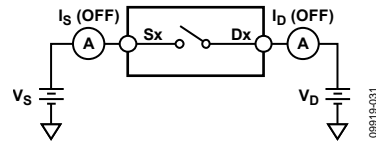


Figure 29. Off Leakage

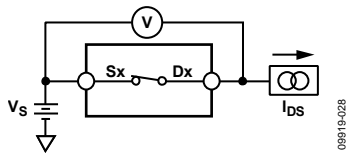


Figure 27. On Resistance

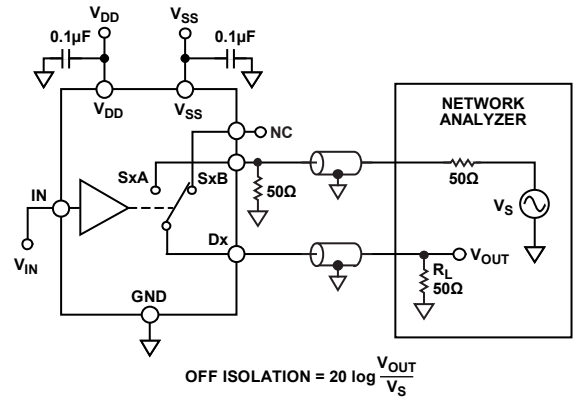


Figure 30. Off Isolation

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

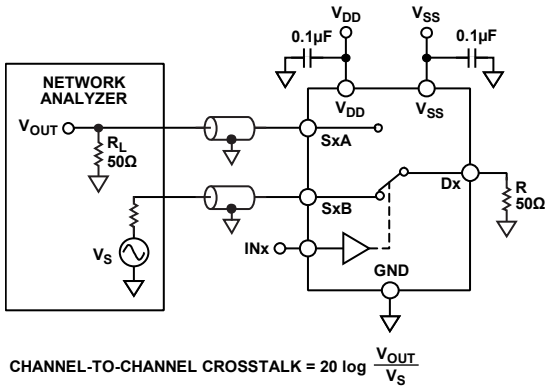


Figure 28. Channel-to-Channel Crosstalk

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

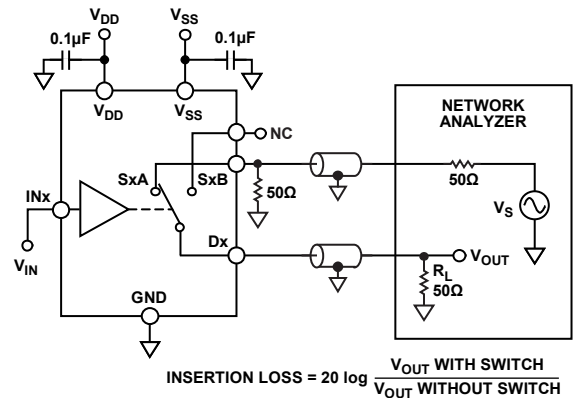


Figure 31. Bandwidth

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

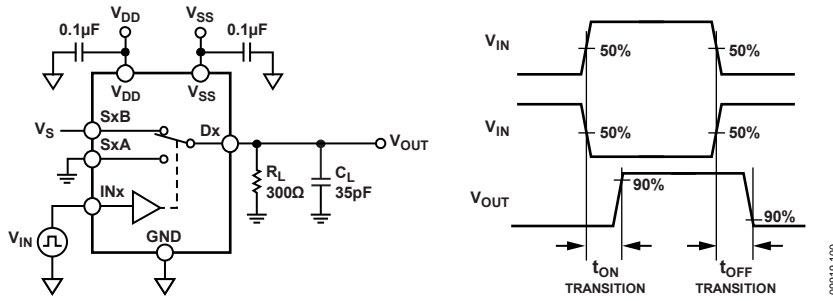


Figure 32. Switching Timing

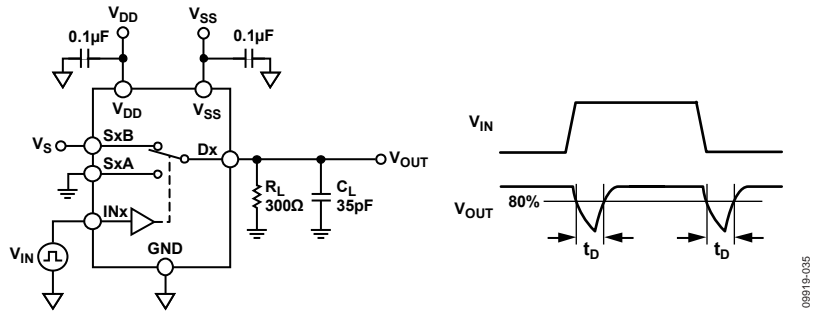


Figure 33. Break-Before-Make Delay,  $t_D$

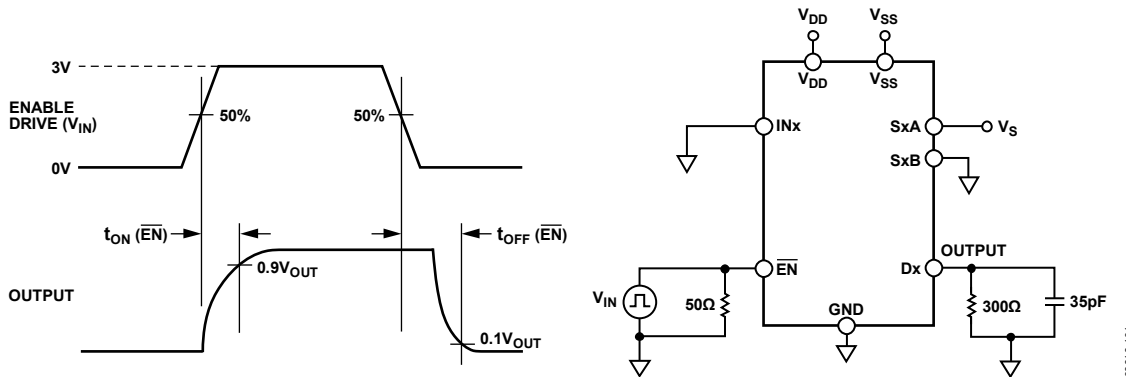


Figure 34. Enable Delay,  $t_{ON}(\overline{EN})$ ,  $t_{OFF}(\overline{EN})$

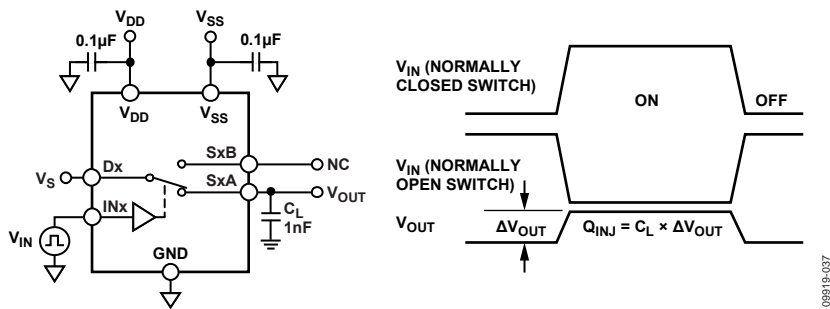


Figure 35. Charge Injection

## 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 Dx and Terminal Sx, respectively.

### $R_{ON}$

$R_{ON}$  is the ohmic resistance between Terminal Dx and Terminal Sx.

### $\Delta R_{ON}$

$\Delta R_{ON}$  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.

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

$t_{ON}(\overline{EN})$  represents the delay time between the 50% and 90% points of the digital input and switch on condition.

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

$t_{OFF}(\overline{EN})$  represents the delay time between the 50% and 90% points of the digital input and switch off condition.

### $t_{TRANSITION}$

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.

### On Response

On response is the frequency response of the on switch.

### AC Power Supply Rejection Ratio (ACPSRR)

ACPSRR is a measure of the ability of a part 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 the signal on the output to the amplitude of the modulation is the ACPSRR.

## TRENCH ISOLATION

In the [ADG5233/ADG5234](#), 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 proof 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. A silicon controlled rectifier (SCR) type circuit is formed by the two transistors 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 proof switch.

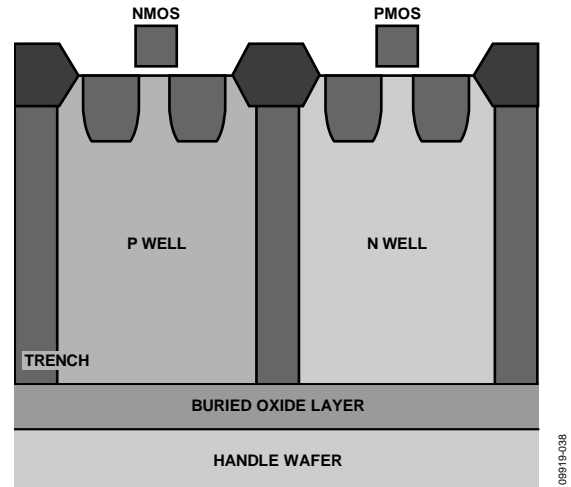


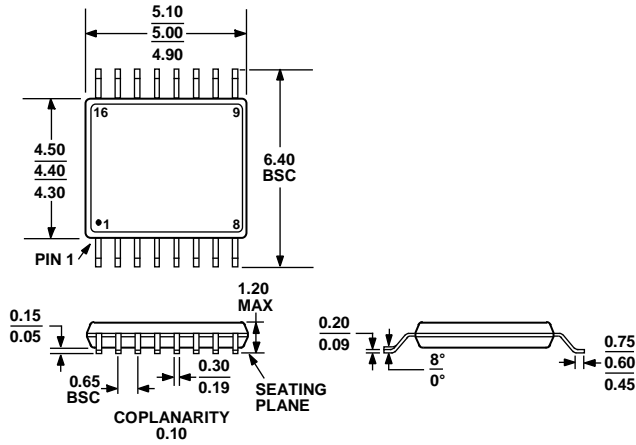
Figure 36. Trench Isolation

## **APPLICATIONS INFORMATION**

The ADG52xx family of switches and multiplexers provide a robust solution for instrumentation, industrial, automotive, 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 [ADG5233/ADG5234](#) high voltage switches allow single-supply operation from 9 V to 40 V and dual supply operation from  $\pm 9$  V to  $\pm 22$  V.

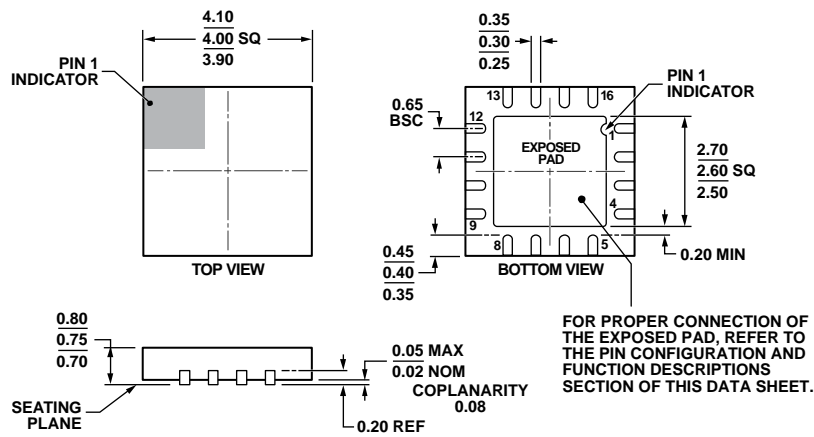
# OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AB

Figure 37. 16-Lead Thin Shrink Small Outline Package [TSSOP] (RU-16)

Dimensions shown in millimeters

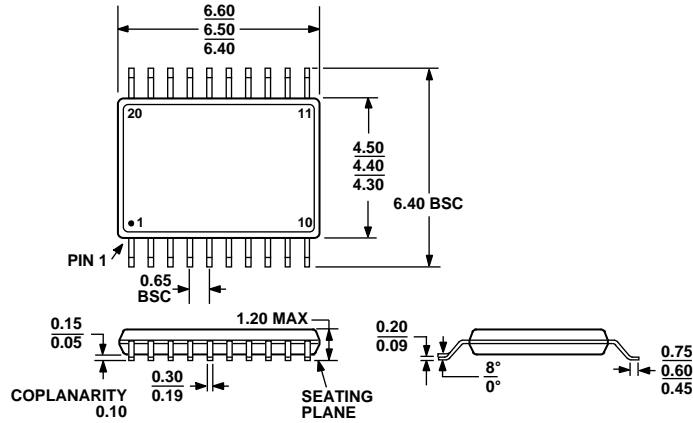


COMPLIANT TO JEDEC STANDARDS MO-220-WGGC.

Figure 38. 16-Lead Lead Frame Chip Scale Package [LF CSP\_WQ] 4 mm x 4 mm Body, Very Very Thin Quad (CP-16-17)

Dimensions shown in millimeters

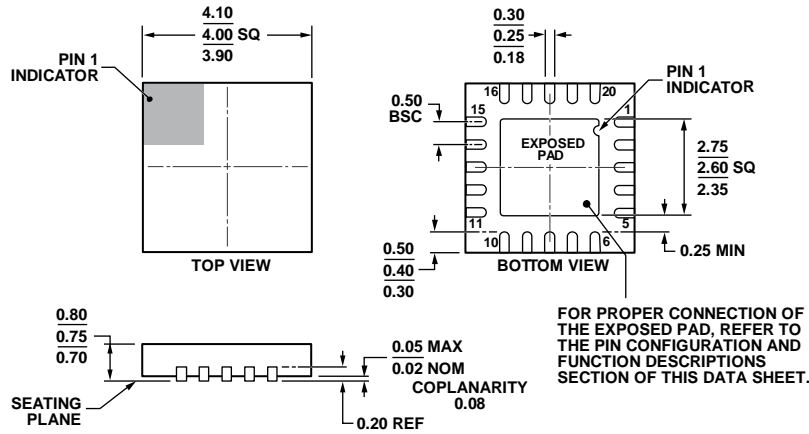
08-16-2010-C



COMPLIANT TO JEDEC STANDARDS MO-153-AC

Figure 39. 20-Lead Thin Shrink Small Outline Package [TSSOP] (RU-20)

Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-220-WGGD.

Figure 40. 20-Lead Lead Frame Chip Scale Package [LFCSP\_WQ] 4 mm x 4 mm Body, Very Very Thin Quad (CP-20-8)

Dimensions shown in millimeters

**ORDERING GUIDE**

Model <sup>1</sup>	Temperature Range	Description	EN Pin	Package Option
ADG5233BRUZ	-40°C to +125°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	Yes	RU-16
ADG5233BRUZ-RL7	-40°C to +125°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	Yes	RU-16
ADG5233BCPZ-RL7	-40°C to +125°C	16-Lead Lead Frame Chip Scale Package [LFCSP_WQ]	Yes	CP-16-17
ADG5234BRUZ	-40°C to +125°C	20-Lead Thin Shrink Small Outline Package [TSSOP]	No	RU-20
ADG5234BRUZ-RL7	-40°C to +125°C	20-Lead Thin Shrink Small Outline Package [TSSOP]	No	RU-20
ADG5234BCPZ-RL7	-40°C to +125°C	20-Lead Lead Frame Chip Scale Package [LFCSP_WQ]	Yes	CP-20-8

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

**NOTES**

**NOTES**