

## ADG1633/ADG1634

### FEATURES

- 4.5  $\Omega$  typical on resistance
- 1  $\Omega$  on-resistance flatness
- Up to 206 mA continuous current
- $\pm 3.3$  V to  $\pm 8$  V dual-supply operation
- 3.3 V to 16 V single-supply operation
- No  $V_L$  supply required
- 3 V logic-compatible inputs
- Rail-to-rail operation

#### ADG1633

16-lead TSSOP and 16-lead, 3 mm  $\times$  3 mm LFCSP

#### ADG1634

20-lead TSSOP and 20-lead, 4 mm  $\times$  4 mm LFCSP

### APPLICATIONS

- Communication systems
- Medical systems
- Audio signal routing
- Video signal routing
- Automatic test equipment
- Data acquisition systems
- Battery-powered systems
- Sample-and-hold systems
- Relay replacements

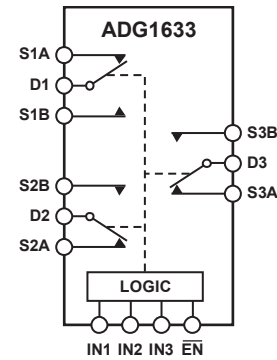
### GENERAL DESCRIPTION

The ADG1633 and ADG1634 are monolithic industrial CMOS (*i*CMOS<sup>®</sup>) 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 ADG1633 (LFCSP and TSSOP packages) and ADG1634 (LFCSP package only) is used to enable or disable the devices. When disabled, all channels are switched off.

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. *i*CMOS construction ensures ultralow power dissipation, making the parts ideally suited for portable and battery-powered instruments.

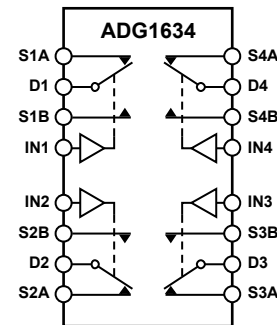
### FUNCTIONAL BLOCK DIAGRAMS



SWITCHES SHOWN FOR  
A 1 INPUT LOGIC.

08319-001

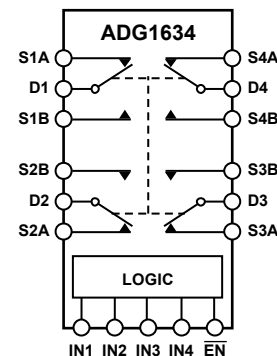
Figure 1. ADG1633 TSSOP and LFCSP\_VQ



SWITCHES SHOWN FOR  
A 1 INPUT LOGIC.

08319-002

Figure 2. ADG1634 TSSOP



SWITCHES SHOWN FOR  
A 1 INPUT LOGIC.

08319-003

Figure 3. ADG1634 LFCSP\_VQ

#### Rev. 0

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

## TABLE OF CONTENTS

Features .....	1	Continuous Current per Channel, S or D .....	7
Applications .....	1	Absolute Maximum Ratings .....	8
General Description .....	1	ESD Caution .....	8
Functional Block Diagrams .....	1	Pin Configurations and Function Descriptions .....	9
Revision History .....	2	Typical Performance Characteristics .....	11
Specifications .....	3	Test Circuits .....	14
$\pm 5$ V Dual Supply .....	3	Terminology .....	16
12 V Single Supply .....	4	Outline Dimensions .....	17
5 V Single Supply .....	5	Ordering Guide .....	19
3.3 V Single Supply .....	6		

## REVISION HISTORY

7/09—Revision 0: Initial Version

# SPECIFICATIONS

## ±5 V DUAL SUPPLY

$V_{DD} = +5\text{ V} \pm 10\%$ ,  $V_{SS} = -5\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ , 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 ( $R_{ON}$ )	4.5			$\Omega$ typ	$V_S = \pm 4.5\text{ V}$ , $I_S = -10\text{ mA}$ ; see Figure 26
	5	7	8	$\Omega$ max	$V_{DD} = \pm 4.5\text{ V}$ , $V_{SS} = \pm 4.5\text{ V}$
On-Resistance Match Between Channels ( $\Delta R_{ON}$ )	0.12			$\Omega$ typ	$V_S = \pm 4.5\text{ V}$ , $I_S = -10\text{ mA}$
	0.25	0.3	0.35	$\Omega$ max	
On-Resistance Flatness ( $R_{FLAT(ON)}$ )	1			$\Omega$ typ	$V_S = \pm 4.5\text{ V}$ , $I_S = -10\text{ mA}$
	1.3	1.7	2	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_S$ (Off)	$\pm 0.01$			nA typ	$V_{DD} = +5.5\text{ V}$ , $V_{SS} = -5.5\text{ V}$
	$\pm 0.1$	$\pm 1.5$	$\pm 12$	nA max	$V_S = \pm 4.5\text{ V}$ , $V_D = \mp 4.5\text{ V}$ ; see Figure 27
Drain Off Leakage, $I_D$ (Off)	$\pm 0.02$			nA typ	$V_S = \pm 4.5\text{ V}$ , $V_D = \mp 4.5\text{ V}$ ; see Figure 27
	$\pm 0.15$	$\pm 2$	$\pm 20$	nA max	
Channel On Leakage, $I_D$ , $I_S$ (On)	$\pm 0.02$			nA typ	$V_S = V_D = \pm 4.5\text{ V}$ ; see Figure 28
	$\pm 0.15$	$\pm 2$	$\pm 20$	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 $I_{INH}$	$\pm 1$			nA typ	$V_{IN} = V_{GND}$ or $V_{DD}$
			$\pm 0.1$	$\mu\text{A}$ max	
Digital Input Capacitance, $C_{IN}$	8			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
Transition Time, $t_{TRANSITION}$	161			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	200	236	264	ns max	$V_S = 2.5\text{ V}$ ; see Figure 29
$t_{ON}(\overline{EN})$	61			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	79	88	98	ns max	$V_S = 2.5\text{ V}$ ; see Figure 31
$t_{OFF}(\overline{EN})$	162			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	199	232	259	ns max	$V_S = 2.5\text{ V}$ ; see Figure 31
Break-Before-Make Time Delay, $t_D$	44			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
			30	ns min	$V_{S1} = V_{S2} = 2.5\text{ V}$ ; see Figure 30
Charge Injection	-12.5			pC typ	$V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 32
Off Isolation	-64			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 33
Channel-to-Channel Crosstalk	-64			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 35
Total Harmonic Distortion + Noise (THD + N)	0.3			% typ	$R_L = 110\ \Omega$ , $V_S = 5\text{ V p-p}$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$ ; see Figure 36
-3 dB Bandwidth	103			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 34
$C_S$ (Off)	19			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (Off)	33			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ , $C_S$ (On)	57			pF typ	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$
<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 = $0\text{ V}$ or $V_{DD}$
$V_{DD}/V_{SS}$			$\pm 3.3/\pm 8$	V min/max	

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

# ADG1633/ADG1634

## 12 V SINGLE SUPPLY

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

Table 2.

Parameter	25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
<b>ANALOG SWITCH</b>					
Analogue Signal Range			0 V to $V_{DD}$	V	
On Resistance ( $R_{ON}$ )	4			$\Omega$ typ	$V_S = 0\text{ V to }10\text{ V}$ , $I_S = -10\text{ mA}$ ; see Figure 26
	4.5	6.5	7.5	$\Omega$ max	$V_{DD} = 10.8\text{ V}$ , $V_{SS} = 0\text{ V}$
On-Resistance Match Between Channels ( $\Delta R_{ON}$ )	0.12			$\Omega$ typ	$V_S = 10\text{ V}$ , $I_S = -10\text{ mA}$
	0.25	0.3	0.35	$\Omega$ max	
On-Resistance Flatness ( $R_{FLAT(ON)}$ )	0.9			$\Omega$ typ	$V_S = 0\text{ V to }10\text{ V}$ , $I_S = -10\text{ mA}$
	1.2	1.6	1.9	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_S$ (Off)	$\pm 0.01$			nA typ	$V_{DD} = 13.2\text{ V}$ , $V_{SS} = 0\text{ V}$
	$\pm 0.1$	$\pm 1.5$	$\pm 12$	nA max	$V_S = 1\text{ V}/10\text{ V}$ , $V_D = 10\text{ V}/1\text{ V}$ ; see Figure 27
Drain Off Leakage, $I_D$ (Off)	$\pm 0.02$			nA typ	$V_S = 1\text{ V}/10\text{ V}$ , $V_D = 10\text{ V}/1\text{ V}$ ; see Figure 27
	$\pm 0.15$	$\pm 2$	$\pm 20$	nA max	
Channel On Leakage, $I_D$ , $I_S$ (On)	$\pm 0.02$			nA typ	$V_S = V_D = 1\text{ V or }10\text{ V}$ ; see Figure 28
	$\pm 0.15$	$\pm 2$	$\pm 20$	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 $I_{INH}$	$\pm 1$			nA typ	$V_{IN} = V_{GND}$ or $V_{DD}$
			$\pm 0.1$	$\mu\text{A}$ max	
Digital Input Capacitance, $C_{IN}$	8			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
Transition Time, $t_{TRANSITION}$	127			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	151	182	205	ns max	$V_S = 8\text{ V}$ ; see Figure 29
$t_{ON}(\overline{EN})$	31			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	38	43	47	ns max	$V_S = 8\text{ V}$ ; see Figure 31
$t_{OFF}(\overline{EN})$	128			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	152	180	200	ns max	$V_S = 8\text{ V}$ ; see Figure 31
Break-Before-Make Time Delay, $t_D$	45			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
			30	ns min	$V_{S1} = V_{S2} = 8\text{ V}$ ; see Figure 30
Charge Injection	-12.4			pC typ	$V_S = 6\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 32
Off Isolation	-64			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 33
Channel-to-Channel Crosstalk	-64			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 35
Total Harmonic Distortion + Noise (THD + N)	0.3			% typ	$R_L = 110\ \Omega$ , $V_S = 5\text{ V p-p}$ , $f = 20\text{ Hz to }20\text{ kHz}$ ; see Figure 36
-3 dB Bandwidth	109			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 34
$C_S$ (Off)	19			pF typ	$V_S = 6\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (Off)	32			pF typ	$V_S = 6\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ , $C_S$ (On)	56			pF typ	$V_S = 6\text{ V}$ , $f = 1\text{ MHz}$
<b>POWER REQUIREMENTS</b>					
$I_{DD}$	0.001			$\mu\text{A}$ typ	$V_{DD} = 12\text{ V}$
			1.0	$\mu\text{A}$ max	Digital inputs = 0 V or $V_{DD}$
TSSOP	300			$\mu\text{A}$ typ	Digital inputs = 5 V
			480	$\mu\text{A}$ max	
LFCSP	375			$\mu\text{A}$ typ	Digital inputs = 5 V
			600	$\mu\text{A}$ max	
$V_{DD}$			3.3/16	V min/max	

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

**5 V SINGLE SUPPLY**

$V_{DD} = 5\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$ , 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 ( $R_{ON}$ )	8.5			$\Omega$ typ	$V_S = 0\text{ V to } 4.5\text{ V}$ , $I_S = -10\text{ mA}$ ; see Figure 26
	10	12.5	14	$\Omega$ max	$V_{DD} = 4.5\text{ V}$ , $V_{SS} = 0\text{ V}$
On-Resistance Match Between Channels ( $\Delta R_{ON}$ )	0.15			$\Omega$ typ	$V_S = 0\text{ V to } 4.5\text{ V}$ , $I_S = -10\text{ mA}$
	0.3	0.35	0.4	$\Omega$ max	
On-Resistance Flatness ( $R_{FLAT(ON)}$ )	1.7			$\Omega$ typ	$V_S = 0\text{ V to } 4.5\text{ V}$ , $I_S = -10\text{ mA}$
	2.3	2.7	3	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_S$ (Off)	$\pm 0.01$			nA typ	$V_{DD} = 5.5\text{ V}$ , $V_{SS} = 0\text{ V}$ $V_S = 1\text{ V}/4.5\text{ V}$ , $V_D = 4.5\text{ V}/1\text{ V}$ ; see Figure 27
	$\pm 0.1$	$\pm 1.5$	$\pm 12$	nA max	
Drain Off Leakage, $I_D$ (Off)	$\pm 0.02$			nA typ	$V_S = 1\text{ V}/4.5\text{ V}$ , $V_D = 4.5\text{ V}/1\text{ V}$ ; see Figure 27
	$\pm 0.15$	$\pm 2$	$\pm 20$	nA max	
Channel On Leakage, $I_D$ , $I_S$ (On)	$\pm 0.02$			nA typ	$V_S = V_D = 1\text{ V or } 4.5\text{ V}$ ; see Figure 28
	$\pm 0.15$	$\pm 2$	$\pm 20$	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 $I_{INH}$	$\pm 1$			nA typ	$V_{IN} = V_{GND}$ or $V_{DD}$
			$\pm 0.1$	$\mu\text{A max}$	
Digital Input Capacitance, $C_{IN}$	8			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
Transition Time, $t_{TRANSITION}$	199			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	254	303	337	ns max	$V_S = 2.5\text{ V}$ ; see Figure 29
$t_{ON}(\overline{EN})$	68			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	90	102	110	ns max	$V_S = 2.5\text{ V}$ ; see Figure 31
$t_{OFF}(\overline{EN})$	201			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	256	300	333	ns max	$V_S = 2.5\text{ V}$ ; see Figure 31
Break-Before-Make Time Delay, $t_D$	57			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
			37	ns min	$V_{S1} = V_{S2} = 2.5\text{ V}$ ; see Figure 30
Charge Injection	-5			pC typ	$V_S = 2.5\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 32
Off Isolation	-64			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ ; see Figure 33
Channel-to-Channel Crosstalk	-64			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ ; see Figure 35
Total Harmonic Distortion + Noise (THD + N)	0.27			% typ	$R_L = 110\ \Omega$ , $f = 20\text{ Hz to } 20\text{ kHz}$ , $V_S = 3.5\text{ V p-p}$ ; see Figure 36
-3 dB Bandwidth	104			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 34
$C_S$ (Off)	21			pF typ	$V_S = 2.5\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (Off)	37			pF typ	$V_S = 2.5\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ , $C_S$ (On)	62			pF typ	$V_S = 2.5\text{ V}$ , $f = 1\text{ MHz}$
<b>POWER REQUIREMENTS</b>					
$I_{DD}$	0.001			$\mu\text{A typ}$	$V_{DD} = 5.5\text{ V}$ Digital inputs = 0 V or $V_{DD}$
			1.0	$\mu\text{A max}$	
$V_{DD}$			3.3/16	V min/max	

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

# ADG1633/ADG1634

## 3.3 V SINGLE SUPPLY

$V_{DD} = 3.3\text{ V}$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$ , 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 ( $R_{ON}$ )	13.5	15	16.5	$\Omega$ typ	$V_S = 0\text{ V}$ to $V_{DD}$ , $I_S = -10\text{ mA}$ ; see Figure 26, $V_{DD} = 3.3\text{ V}$ , $V_{SS} = 0\text{ V}$
On-Resistance Match Between Channels ( $\Delta R_{ON}$ )	0.25	0.28	0.3	$\Omega$ typ	$V_S = 0\text{ V}$ to $V_{DD}$ , $I_S = -10\text{ mA}$
On-Resistance Flatness ( $R_{FLAT(ON)}$ )	5	5.5	6.5	$\Omega$ typ	$V_S = 0\text{ V}$ to $V_{DD}$ , $I_S = -10\text{ mA}$
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_S$ (Off)	$\pm 0.01$			nA typ	$V_{DD} = 3.6\text{ V}$ , $V_{SS} = 0\text{ V}$
	$\pm 0.1$	$\pm 1.5$	$\pm 12$	nA max	$V_S = 0.6\text{ V}/3\text{ V}$ , $V_D = 3\text{ V}/0.6\text{ V}$ ; see Figure 27
Drain Off Leakage, $I_D$ (Off)	$\pm 0.01$			nA typ	$V_S = 0.6\text{ V}/3\text{ V}$ , $V_D = 3\text{ V}/0.6\text{ V}$ ; see Figure 27
	$\pm 0.15$	$\pm 2$	$\pm 20$	nA max	
Channel On Leakage, $I_D$ , $I_S$ (On)	$\pm 0.01$			nA typ	$V_S = V_D = 0.6\text{ V}$ or $3\text{ V}$ ; see Figure 28
	$\pm 0.15$	$\pm 2$	$\pm 20$	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 $I_{INH}$	$\pm 1$			nA typ	$V_{IN} = V_{GND}$ or $V_{DD}$
			$\pm 0.1$	$\mu\text{A}$ max	
Digital Input Capacitance, $C_{IN}$	8			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
Transition Time, $t_{TRANSITION}$	309			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	429	466	508	ns max	$V_S = 1.5\text{ V}$ ; see Figure 29
$t_{ON}(\overline{EN})$	132			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	184	201	210	ns max	$V_S = 1.5\text{ V}$ ; see Figure 31
$t_{OFF}(\overline{EN})$	313			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
	416	470	509	ns max	$V_S = 1.5\text{ V}$ ; see Figure 31
Break-Before-Make Time Delay, $t_D$	81			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$
			48	ns min	$V_{S1} = V_{S2} = 1.5\text{ V}$ ; see Figure 30
Charge Injection	-10			pC typ	$V_S = 1.5\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 32
Off Isolation	-64			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ ; see Figure 33
Channel-to-Channel Crosstalk	-64			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 100\text{ kHz}$ ; see Figure 35
Total Harmonic Distortion + Noise (THD + N)	0.6			% typ	$R_L = 110\ \Omega$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$ , $V_S = 2\text{ V p-p}$ ; see Figure 36
-3 dB Bandwidth	117			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 34
$C_S$ (Off)	22			pF typ	$V_S = 1.5\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ (Off)	39			pF typ	$V_S = 1.5\text{ V}$ , $f = 1\text{ MHz}$
$C_D$ , $C_S$ (On)	64			pF typ	$V_S = 1.5\text{ V}$ , $f = 1\text{ MHz}$
<b>POWER REQUIREMENTS</b>					
$I_{DD}$	0.001			$\mu\text{A}$ typ	$V_{DD} = 3.6\text{ V}$
			1.0	$\mu\text{A}$ max	Digital inputs = 0 V or $V_{DD}$
$V_{DD}$			3.3/16	V min/max	

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

**CONTINUOUS CURRENT PER CHANNEL, S OR D**

Table 5. ADG1633

Parameter	25°C	85°C	125°C	Unit
CONTINUOUS CURRENT, S OR D				
$V_{DD} = +5\text{ V}, V_{SS} = -5\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	126	84	56	mA max
LFCSP ( $\theta_{JA} = 48.7^\circ\text{C/W}$ )	206	126	70	mA max
$V_{DD} = 12\text{ V}, V_{SS} = 0\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	133	87	56	mA max
LFCSP ( $\theta_{JA} = 48.7^\circ\text{C/W}$ )	213	133	73	mA max
$V_{DD} = 5\text{ V}, V_{SS} = 0\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	98	70	45	mA max
LFCSP ( $\theta_{JA} = 48.7^\circ\text{C/W}$ )	157	105	63	mA max
$V_{DD} = 3.3\text{ V}, V_{SS} = 0\text{ V}$				
TSSOP ( $\theta_{JA} = 112.6^\circ\text{C/W}$ )	77	56	38	mA max
LFCSP ( $\theta_{JA} = 48.7^\circ\text{C/W}$ )	129	87	56	mA max

Table 6. ADG1634

Parameter	25°C	85°C	125°C	Unit
CONTINUOUS CURRENT, S OR D				
$V_{DD} = +5\text{ V}, V_{SS} = -5\text{ V}$				
TSSOP ( $\theta_{JA} = 95^\circ\text{C/W}$ )	112	77	52	mA max
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	220	136	73	mA max
$V_{DD} = 12\text{ V}, V_{SS} = 0\text{ V}$				
TSSOP ( $\theta_{JA} = 95^\circ\text{C/W}$ )	119	80	52	mA max
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	234	140	73	mA max
$V_{DD} = 5\text{ V}, V_{SS} = 0\text{ V}$				
TSSOP ( $\theta_{JA} = 95^\circ\text{C/W}$ )	87	63	42	mA max
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	171	112	66	mA max
$V_{DD} = 3.3\text{ V}, V_{SS} = 0\text{ V}$				
TSSOP ( $\theta_{JA} = 95^\circ\text{C/W}$ )	70	52	35	mA max
LFCSP ( $\theta_{JA} = 30.4^\circ\text{C/W}$ )	140	94	59	mA max

## ABSOLUTE MAXIMUM RATINGS

T<sub>A</sub> = 25°C, unless otherwise noted.

Table 7.

Parameter	Rating
V <sub>DD</sub> to V <sub>SS</sub>	18 V
V <sub>DD</sub> to GND	-0.3 V to +18 V
V <sub>SS</sub> to GND	+0.3 V to -18 V
Analog Inputs <sup>1</sup>	V <sub>SS</sub> - 0.3 V to V <sub>DD</sub> + 0.3 V or 30 mA, whichever occurs first
Digital Inputs <sup>1</sup>	GND - 0.3 V to V <sub>DD</sub> + 0.3 V or 30 mA, whichever occurs first
Peak Current, S or D	450 mA (pulsed at 1 ms, 10% duty cycle maximum)
Continuous Current, S or D <sup>2</sup>	Data + 15%
Operating Temperature Range	
Industrial (Y Version)	-40°C to +125°C
Storage Temperature Range	-65°C to +150°C
Junction Temperature	150°C
16-Lead TSSOP, θ <sub>JA</sub> Thermal Impedance, 0 Airflow (4-Layer Board)	112.6°C/W
20-Lead TSSOP, θ <sub>JA</sub> Thermal Impedance, 0 Airflow (4-Layer Board)	95°C/W
16-Lead LFCSP (3 mm × 3 mm), θ <sub>JA</sub> Thermal Impedance, 0 Airflow (4-Layer Board)	48.7°C/W
16-Lead LFCSP (4 mm × 4 mm), θ <sub>JA</sub> Thermal Impedance, 0 Airflow (4-Layer Board)	30.4°C/W
Reflow Soldering Peak Temperature, Pb free	260°C

<sup>1</sup> Overvoltages at IN, S, or D are clamped by internal diodes. Current should be limited 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.

### 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

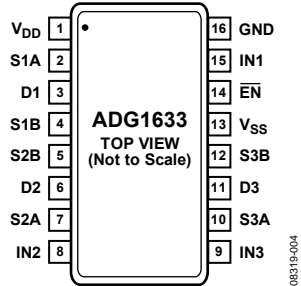
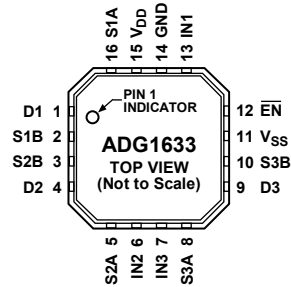


Figure 4. ADG1633 TSSOP Pin Configuration



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

Figure 5. ADG1633 LFCSP\_VQ Pin Configuration

Table 8. ADG1633 Pin Function Descriptions

Pin No.		Mnemonic	Description
TSSOP	LFCSP_VQ		
1	15	$V_{DD}$	Most Positive Power Supply Potential.
2	16	S1A	Source Terminal 1A. Can be an input or an output.
3	1	D1	Drain Terminal 1. Can be an input or an output.
4	2	S1B	Source Terminal 1B. Can be an input or an output.
5	3	S2B	Source Terminal 2B. Can be an input or an output.
6	4	D2	Drain Terminal 2. Can be an input or an output.
7	5	S2A	Source Terminal 2A. 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. Can be an input or an output.
11	9	D3	Drain Terminal 3. Can be an input or an output.
12	10	S3B	Source Terminal 3B. Can be an input or an output.
13	11	$V_{SS}$	Most Negative Power Supply Potential. In single-supply applications, this pin can be connected to ground.
14	12	$\overline{EN}$	Active Low Digital Input. When this pin is high, the device is disabled and all switches are off. When this pin is low, INx logic inputs determine the on switches.
15	13	IN1	Logic Control Input 1.
16	14	GND	Ground (0 V) Reference.
N/A	17	EP	Exposed Pad. The exposed pad is tied to the substrate, $V_{SS}$ .

Table 9. ADG1633 Truth Table

$\overline{EN}$	INx	SxA	SxB
1	X <sup>1</sup>	Off	Off
0	0	Off	On
0	1	On	Off

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

# ADG1633/ADG1634

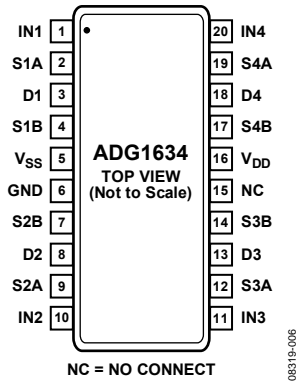
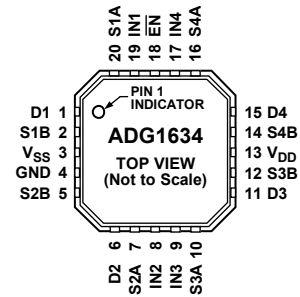


Figure 6. ADG1634 TSSOP Pin Configuration



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

Figure 7. ADG1634 LFCSP\_VQ Pin Configuration

Table 10. ADG1634 Pin Function Descriptions

Pin No.		Mnemonic	Description
TSSOP	LFCSP_VQ		
1	19	IN1	Logic Control Input 1.
2	20	S1A	Source Terminal 1A. Can be an input or an output.
3	1	D1	Drain Terminal 1. Can be an input or an output.
4	2	S1B	Source Terminal 1B. Can be an input or an output.
5	3	$V_{SS}$	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. Can be an input or an output.
8	6	D2	Drain Terminal 2. Can be an input or an output.
9	7	S2A	Source Terminal 2A. 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. Can be an input or an output.
13	11	D3	Drain Terminal 3. Can be an input or an output.
14	12	S3B	Source Terminal 3B. Can be an input or an output.
15	N/A	NC	No Connect.
16	13	$V_{DD}$	Most Positive Power Supply Potential.
17	14	S4B	Source Terminal 4B. Can be an input or an output.
18	15	D4	Drain Terminal 4. Can be an input or an output.
19	16	S4A	Source Terminal 4A. Can be an input or an output.
20	17	IN4	Logic Control Input 4.
N/A	18	$\overline{EN}$	Active Low Digital Input. When this pin is high, the device is disabled and all switches are off. When this pin is low, $IN_x$ logic inputs determine the on switches.
N/A	21	EP	Exposed Pad. The exposed pad is tied to the substrate, $V_{SS}$ .

Table 11. ADG1634 TSSOP Truth Table

$IN_x$	$S_xA$	$S_xB$
0	Off	On
1	On	Off

Table 12. ADG1634 LFCSP\_VQ Truth Table

$\overline{EN}$	$IN_x$	$S_xA$	$S_xB$
1	X <sup>1</sup>	Off	Off
0	0	Off	On
0	1	On	Off

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

# TYPICAL PERFORMANCE CHARACTERISTICS

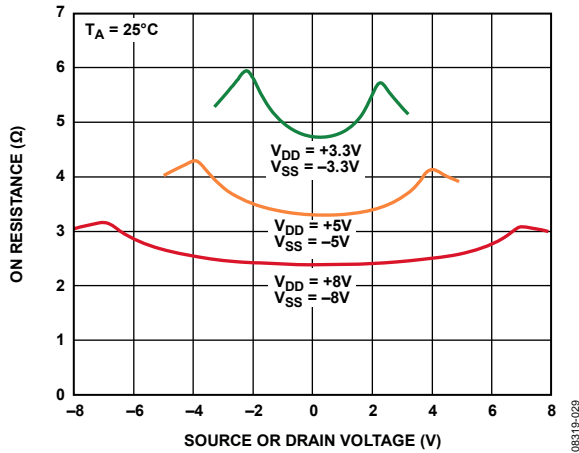


Figure 8. On Resistance vs.  $V_D$  ( $V_S$ ), Dual Supply

08319-029

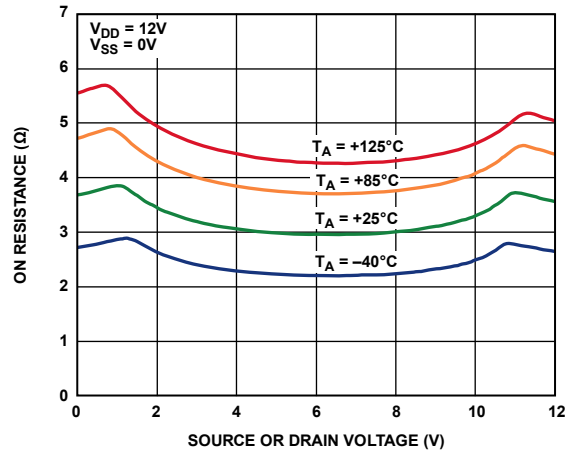


Figure 11. On Resistance vs.  $V_D$  ( $V_S$ ) for Different Temperatures, 12 V Single Supply

08319-032

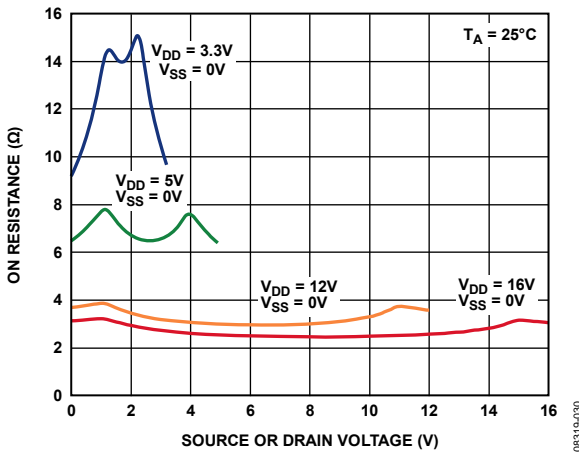


Figure 9. On Resistance vs.  $V_D$  ( $V_S$ ), Single Supply

08319-030

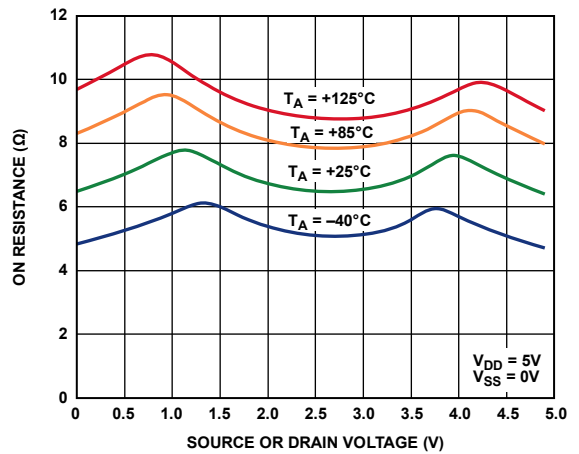


Figure 12. On Resistance vs.  $V_D$  ( $V_S$ ) for Different Temperatures, 5 V Single Supply

08319-033

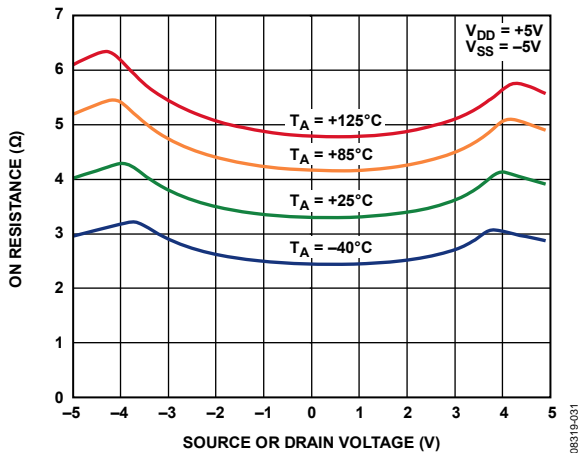


Figure 10. On Resistance vs.  $V_D$  ( $V_S$ ) for Different Temperatures,  $\pm 5$  V Dual Supply

08319-031

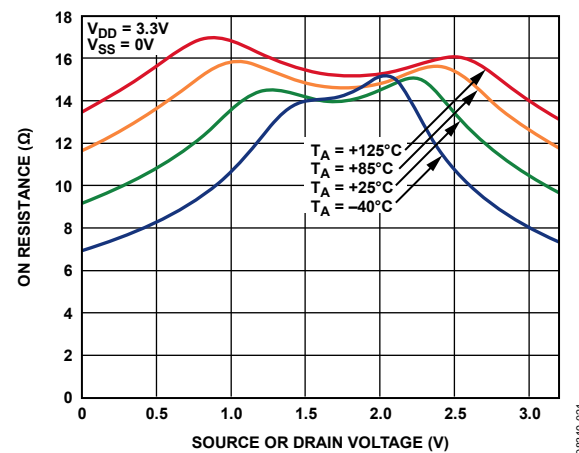


Figure 13. On Resistance vs.  $V_D$  ( $V_S$ ) for Different Temperatures, 3.3 V Single Supply

08319-021

# ADG1633/ADG1634

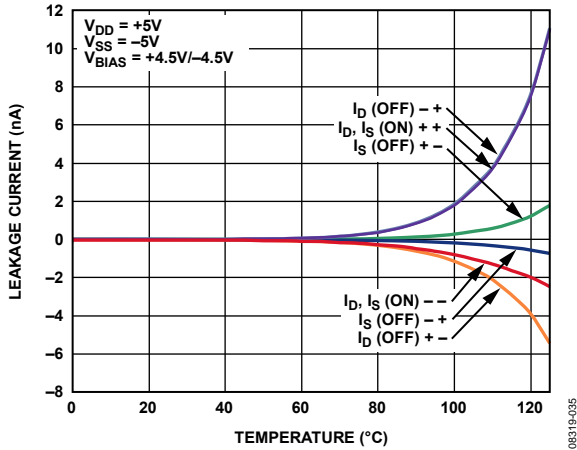


Figure 14. ADG1633 Leakage Currents vs. Temperature, ±5V Dual Supply

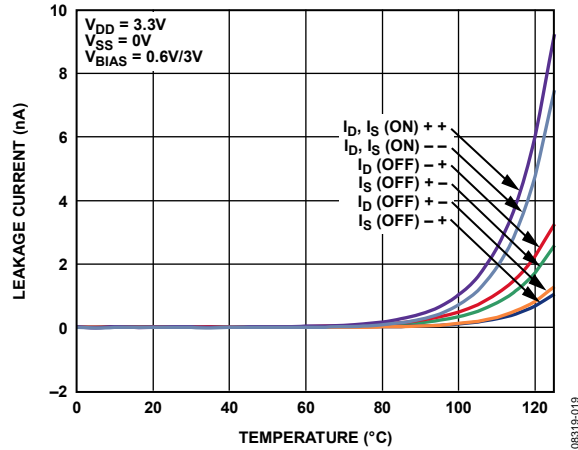


Figure 17. ADG1633 Leakage Currents vs. Temperature, 3.3V Single Supply

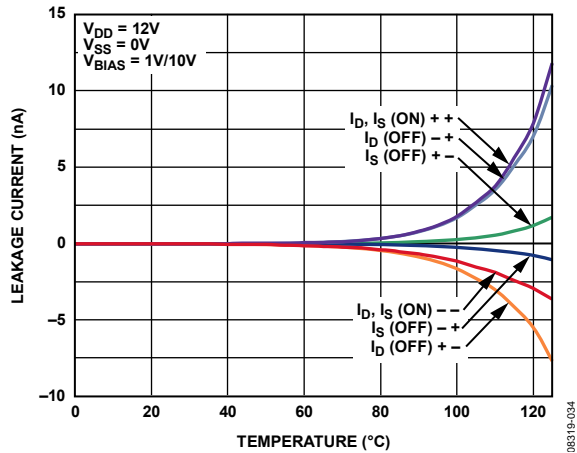


Figure 15. ADG1633 Leakage Currents vs. Temperature, 12V Single Supply

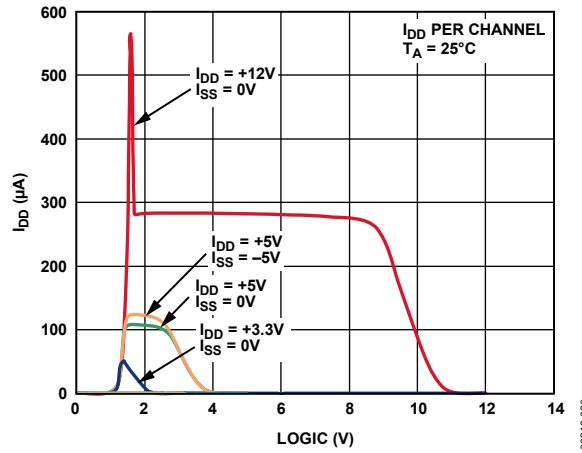


Figure 18.  $I_{DD}$  vs. Logic Level

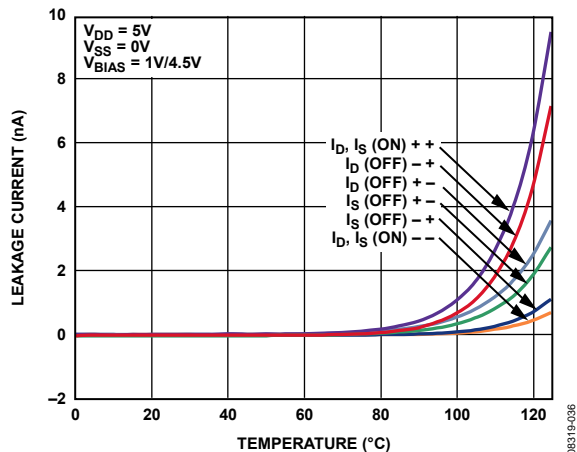


Figure 16. ADG1633 Leakage Currents vs. Temperature, 5V Single Supply

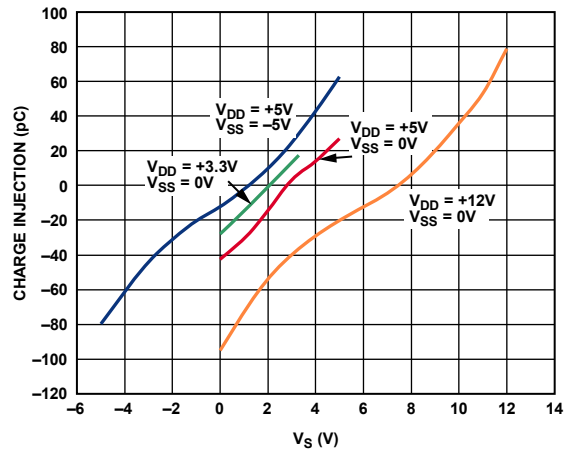


Figure 19. Charge Injection vs. Source Voltage

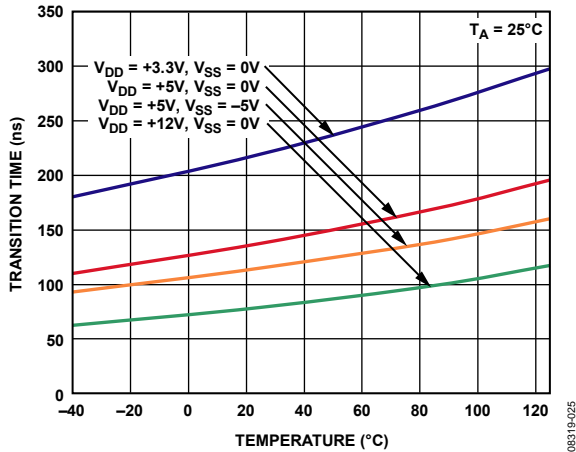


Figure 20. Transition Time vs. Temperature

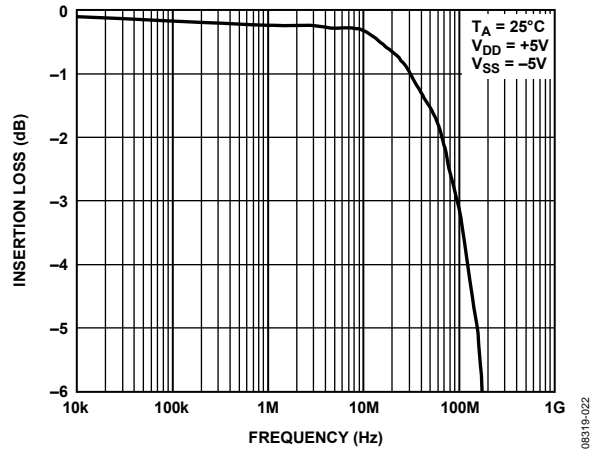


Figure 23. On Response vs. Frequency

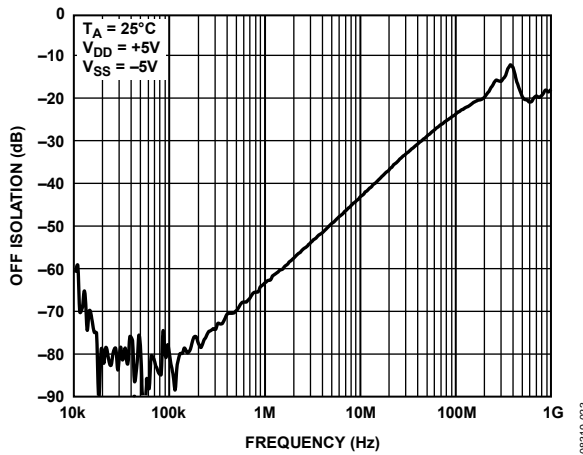


Figure 21. Off Isolation vs. Frequency

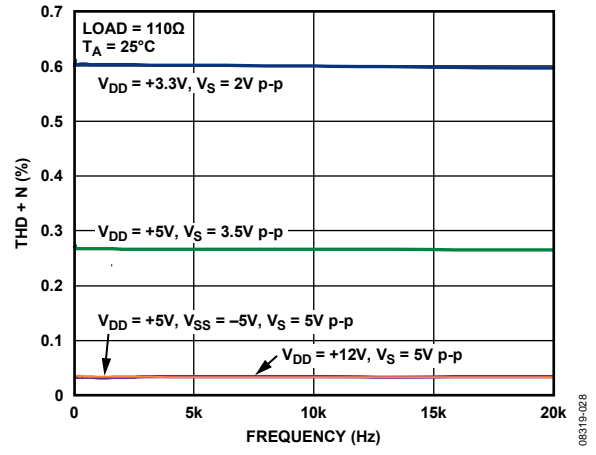


Figure 24. THD + N vs. Frequency

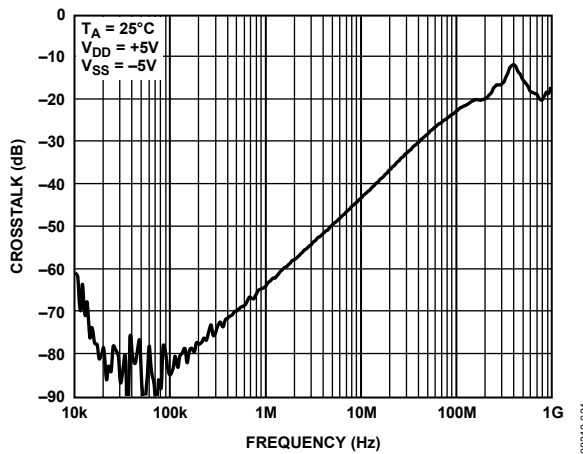


Figure 22. Crosstalk vs. Frequency

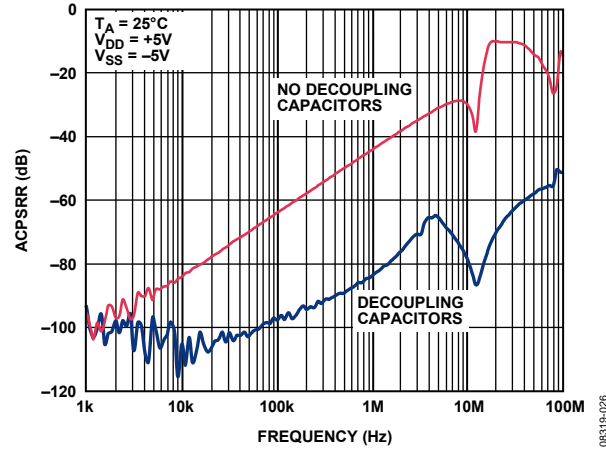


Figure 25. ACPSRR vs. Frequency

## TEST CIRCUITS

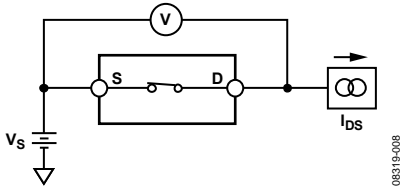


Figure 26. On Resistance

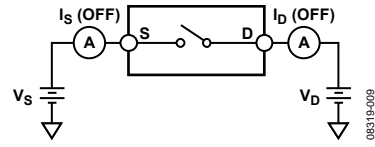


Figure 27. Off Leakage

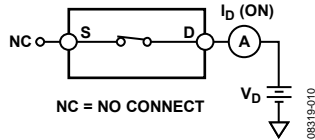


Figure 28. On Leakage

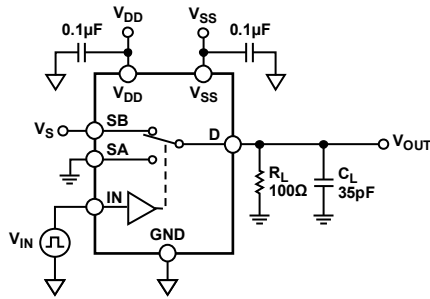


Figure 29. Switching Timing

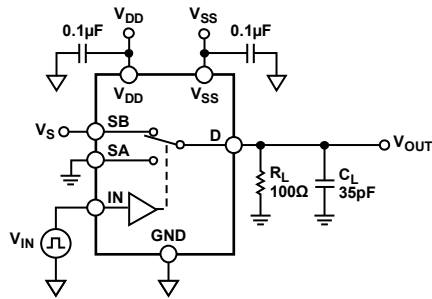
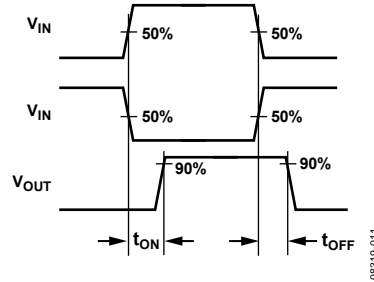


Figure 30. Break-Before-Make Delay,  $t_D$

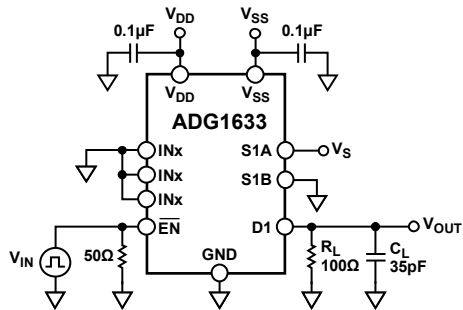
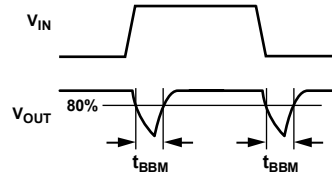
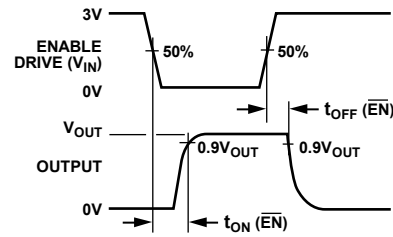


Figure 31. Enable Delay,  $t_{ON}(\overline{EN})$ ,  $t_{OFF}(\overline{EN})$



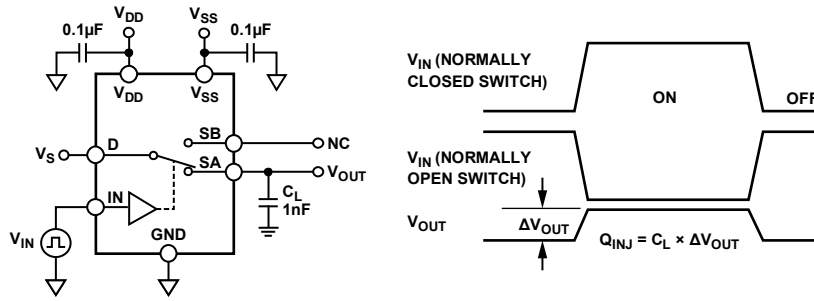


Figure 32. Charge Injection

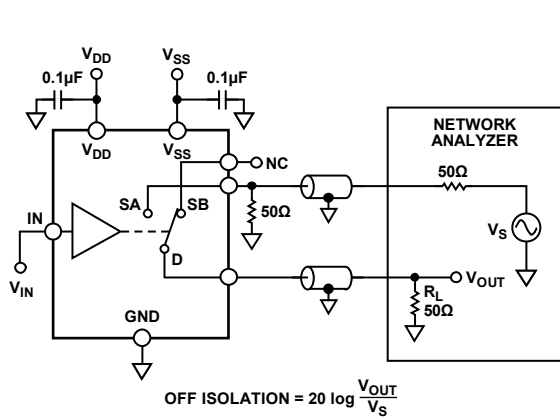


Figure 33. Off Isolation

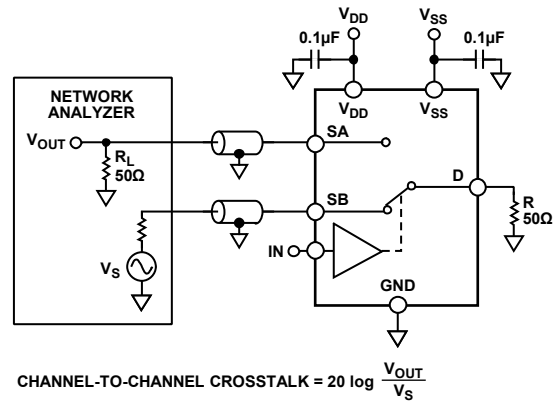


Figure 35. Channel-to-Channel Crosstalk

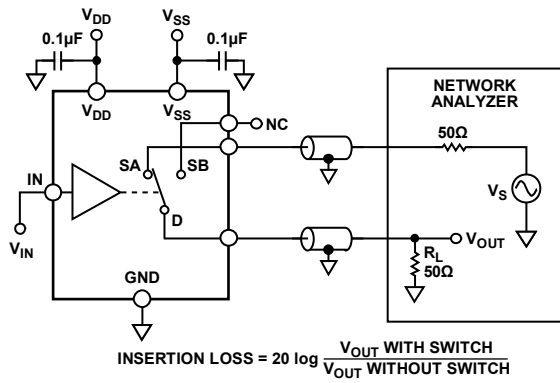


Figure 34. Bandwidth

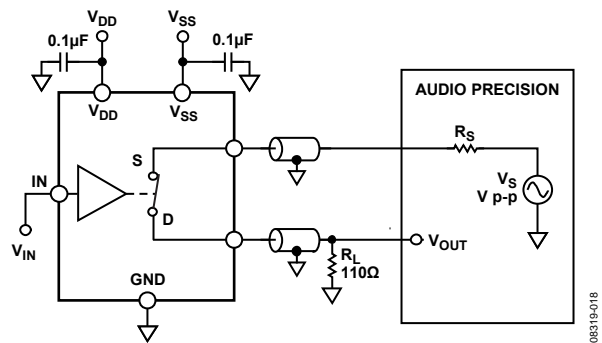


Figure 36. THD + Noise

## TERMINOLOGY

**R<sub>ON</sub>**

Ohmic resistance between Terminal D and Terminal S.

**ΔR<sub>ON</sub>**

The difference between the R<sub>ON</sub> of any two channels.

**R<sub>FLAT(ON)</sub>**

The difference between the maximum and minimum value of on resistance measured.

**I<sub>S</sub> (Off)**

Source leakage current when the switch is off.

**I<sub>D</sub> (Off)**

Drain leakage current when the switch is off.

**I<sub>D</sub>, I<sub>S</sub> (On)**

Channel leakage current when the switch is on.

**V<sub>D</sub> (V<sub>S</sub>)**

Analog voltage on Terminal D and Terminal S.

**C<sub>S</sub> (Off)**

Channel input capacitance for off condition.

**C<sub>D</sub> (Off)**

Channel output capacitance for off condition.

**C<sub>D</sub>, C<sub>S</sub> (On)**

On switch capacitance.

**C<sub>IN</sub>**

Digital input capacitance.

**t<sub>ON</sub> ( $\overline{EN}$ )**

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

**t<sub>OFF</sub> ( $\overline{EN}$ )**

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

**t<sub>TRANS</sub>**

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<sub>BBM</sub>**

Off time measured between the 80% point of both switches when switching from one address state to another.

**V<sub>IL</sub>**

Maximum input voltage for Logic 0.

**V<sub>IH</sub>**

Minimum input voltage for Logic 1.

**I<sub>IL</sub> (I<sub>IH</sub>)**

Input current of the digital input.

**I<sub>DD</sub>**

Positive supply current.

**I<sub>SS</sub>**

Negative supply current.

**Off Isolation**

A measure of unwanted signal coupling through an off channel.

**Charge Injection**

A measure of the glitch impulse transferred from the digital input to the analog output during switching.

**Bandwidth**

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

**On Response**

The frequency response of the on switch.

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

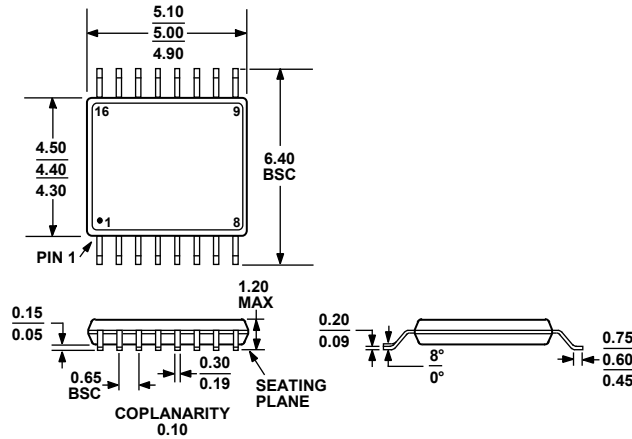
The ratio of the harmonic amplitude plus noise of the signal to the fundamental.

**AC Power Supply Rejection Ratio (ACPSRR)**

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 signal on the output to the amplitude of the modulation is the ACPSRR.



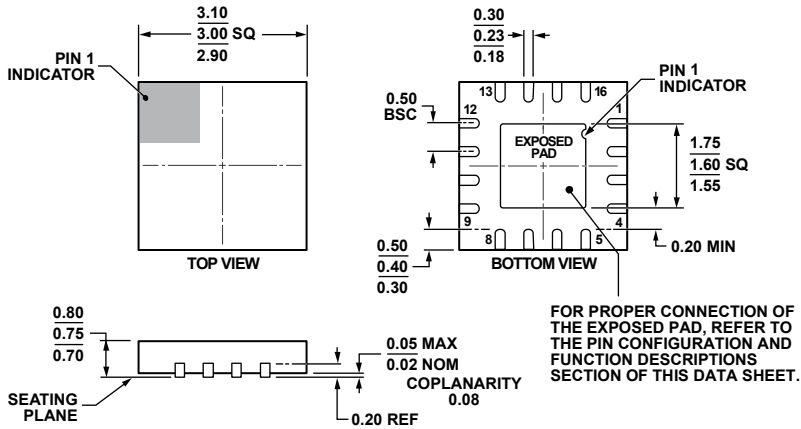
OUTLINE DIMENSIONS



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-WEED.

Figure 38. 16-Lead Lead Frame Chip Scale Package [LF CSP\_WQ] 3 mm x 3 mm, Very VeryThin Quad (CP-16-22)

Dimensions shown in millimeters

070208-C



**ORDERING GUIDE**

<b>Model</b>	<b>Temperature Range</b>	<b>Description</b>	<b><math>\overline{\text{EN}}</math> Pin</b>	<b>Package Option</b>	<b>Branding</b>
ADG1633BRUZ <sup>1</sup>	-40°C to +125°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	Yes	RU-16	
ADG1633BRUZ-REEL7 <sup>1</sup>	-40°C to +125°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	Yes	RU-16	
ADG1633BCPZ-REEL7 <sup>1</sup>	-40°C to +125°C	16-Lead Lead Frame Chip Scale Package [LFCSP_WQ]	Yes	CP-16-22	S3D
ADG1634BRUZ <sup>1</sup>	-40°C to +125°C	20-Lead Thin Shrink Small Outline Package [TSSOP]	No	RU-20	
ADG1634BRUZ-REEL7 <sup>1</sup>	-40°C to +125°C	20-Lead Thin Shrink Small Outline Package [TSSOP]	No	RU-20	
ADG1634BCPZ-REEL7 <sup>1</sup>	-40°C to +125°C	20-Lead Lead Frame Chip Scale Package [LFCSP_VQ]	Yes	CP-20-4	

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

**NOTES**