

FEATURES

44 V Supply Maximum Ratings

V_{SS} to V_{DD} Analog Signal Range

Low On Resistance ($45\ \Omega$ max)

Low ΔR_{ON} ($5\ \Omega$ max)

Low R_{ON} Match ($4\ \Omega$ max)

Low Power Dissipation

Fast Switching Times

$t_{ON} < 175\text{ ns}$

$t_{OFF} < 145\text{ ns}$

Low Leakage Currents (5 nA max)

Low Charge Injection (10 pC max)

Break-Before-Make Switching Action

APPLICATIONS

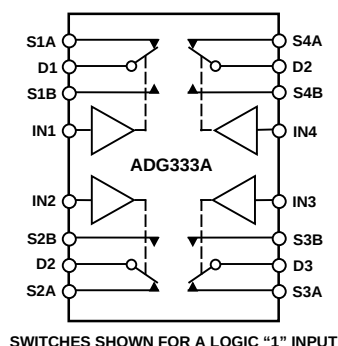
Audio and Video Switching

Battery Powered Systems

Test Equipment

Communication Systems

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADG333A is a monolithic CMOS device comprising four independently selectable SPDT switches. It is designed on an LC^2 MOS process which provides low power dissipation yet achieves a high switching speed and a low on resistance.

The on resistance profile is very flat over the full analog input range ensuring good linearity and low distortion when switching audio signals. High switching speed also makes the part suitable for video signal switching. CMOS construction ensures ultralow power dissipation making the part ideally suited for portable, battery powered instruments.

When they are ON, each switch conducts equally well in both directions and has an input signal range which extends to the power supplies. In the OFF condition, signal levels up to the supplies are blocked. All switches exhibit break-before-make switching action for use in multiplexer applications. Inherent in the design is low charge injection for minimum transients when switching the digital inputs.

PRODUCT HIGHLIGHTS

1. **Extended Signal Range**
The ADG333A is fabricated on an enhanced LC^2 MOS process, giving an increased signal range which extends to the supply rails.
2. **Low Power Dissipation**
3. **Low R_{ON}**
4. **Single Supply Operation**
For applications where the analog signal is unipolar, the ADG333A can be operated from a single rail power supply. The part is fully specified with a single +12 V supply.

REV. 0

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ADG333A—SPECIFICATIONS¹

DUAL SUPPLY ($V_{DD} = +15\text{ V}$, $V_{SS} = -15\text{ V}$, $GND = 0\text{ V}$, unless otherwise noted)

Parameter	+25°C	−40°C to +85°C	Units	Test Conditions/Comments
ANALOG SWITCH				
Analog Signal Range		V_{SS} to V_{DD}	V	
R_{ON}	20		Ω typ	$V_D = \pm 10\text{ V}$, $I_S = -1\text{ mA}$
	45	45	Ω max	
ΔR_{ON}		5	Ω max	$V_D = \pm 5\text{ V}$, $I_S = -10\text{ mA}$
R_{ON} Match		4	Ω max	$V_D = \pm 10\text{ V}$, $I_S = -10\text{ mA}$
LEAKAGE CURRENTS				
Source OFF Leakage I_S (OFF)	± 0.1		nA typ	$V_{DD} = +16.5\text{ V}$, $V_{SS} = -16.5\text{ V}$
	± 0.25	± 3	nA max	$V_D = \pm 15.5\text{ V}$, $V_S = +15.5\text{ V}$
Channel ON Leakage I_D , I_S (ON)	± 0.1		nA typ	Test Circuit 2
	± 0.4	± 5	nA max	$V_S = V_D = \pm 15.5\text{ V}$
				Test Circuit 3
DIGITAL INPUTS				
Input High Voltage, V_{INH}		2.4	V min	
Input Low Voltage, V_{INL}		0.8	V max	
Input Current				
I_{INL} or I_{INH}		± 0.005	μA typ	$V_{IN} = 0\text{ V}$ or V_{DD}
		± 0.5	μA max	
DYNAMIC CHARACTERISTICS²				
t_{ON}	90		ns typ	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$;
		175	ns max	$V_S = \pm 10\text{ V}$; Test Circuit 4
t_{OFF}	80		ns typ	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$;
		145	ns max	$V_S = \pm 10\text{ V}$; Test Circuit 4
Break-Before-Make Delay, t_{OPEN}	10		ns min	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$;
				$V_S = +5\text{ V}$; Test Circuit 5
Charge Injection	2		pC typ	$V_D = 0\text{ V}$, $R_D = 0\ \Omega$, $C_L = 10\text{ nF}$;
	10		pC max	$V_{DD} = +15\text{ V}$, $V_{SS} = -15\text{ V}$; Test Circuit 6
OFF Isolation	72		dB typ	$R_L = 75\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$;
				$V_S = 2.3\text{ V rms}$, Test Circuit 7
Channel-to-Channel Crosstalk	85		dB typ	$R_L = 75\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$;
				$V_S = 2.3\text{ V rms}$, Test Circuit 8
C_S (OFF)	5		pF typ	
C_D , C_S (ON)	20		pF typ	
POWER REQUIREMENTS				
I_{DD}	0.05		mA typ	Digital Inputs = 0 V or 5 V
	0.25	0.35	mA max	
I_{SS}	0.01		μA typ	
	1	5	μA max	
V_{DD}/V_{SS}		$\pm 3/\pm 20$	V min/V max	$ V_{DD} = V_{SS} $

NOTES

¹Temperature range is as follows: B Version: -40°C to $+85^\circ\text{C}$.

²Guaranteed by design, not subject to production test.

Specifications subject to change without notice.

SINGLE SUPPLY ($V_{DD} = +12\text{ V}$, $V_{SS} = 0\text{ V} \pm 10\%$, $GND = 0\text{ V}$, unless otherwise noted)

Parameter	+25°C	–40°C to +85°C	Units	Test Conditions/Comments
ANALOG SWITCH Analog Signal Range R_{ON}	35	0 to V_{DD} 75	V Ω typ Ω max	$V_D = +1\text{ V}$, $+10\text{ V}$, $I_S = -1\text{ mA}$
LEAKAGE CURRENTS Source OFF Leakage I_S (OFF) Channel ON Leakage I_D , I_S (ON)	± 0.1 ± 0.25 ± 0.1 ± 0.4	± 3 ± 5	nA typ nA max nA typ nA max	$V_{DD} = +13.2\text{ V}$ $V_D = 12.2\text{ V}/1\text{ V}$, $V_S = 1\text{ V}/12.2\text{ V}$ Test Circuit 2 $V_S = V_D = 12.2\text{ V}/1\text{ V}$ Test Circuit 3
DIGITAL INPUTS Input High Voltage, V_{INH} Input Low Voltage, V_{INL} Input Current I_{INL} or I_{INH}		2.4 0.8 ± 0.005 ± 0.5	V min V max μA typ μA max	$V_{IN} = 0\text{ V}$ or V_{DD}
DYNAMIC CHARACTERISTICS ² t_{ON} t_{OFF} Break-Before-Make Delay, t_{OPEN} Charge Injection OFF Isolation Channel-to-Channel Crosstalk C_S (OFF) C_D , C_S (ON)	110 100 10 5 72 85 5 20	200 180	ns typ ns max ns typ ns max ns min ns min pC typ dB typ dB typ pF typ pF typ	$R_L = 300\ \Omega$, $C_L = 35\text{ pF}$; $V_S = +8\text{ V}$; Test Circuit 4 $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$; $V_S = +8\text{ V}$; Test Circuit 4 $R_L = 300\ \Omega$, $C_L = 35\text{ pF}$; $V_S = +5\text{ V}$; Test Circuit 5 $V_D = 6\text{ V}$, $R_D = 0\ \Omega$, $C_L = 10\text{ nF}$; $V_{DD} = +12\text{ V}$, $V_{SS} = -0\text{ V}$; Test Circuit 6 $R_L = 75\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; $V_S = 1.15\text{ V rms}$, Test Circuit 7 $R_L = 75\ \Omega$, $C_L = 5\text{ pF}$, $f = 1\text{ MHz}$; $V_S = 1.15\text{ V rms}$, Test Circuit 8
POWER REQUIREMENTS I_{DD} V_{DD}	0.05 0.25	0.35 +3/+30	mA typ mA max V min/V max	$V_{DD} = +13.5\text{ V}$ Digital Inputs = 0 V or 5 V

NOTES

¹Temperature range is as follows: B Version: -40°C to $+85^\circ\text{C}$.²Guaranteed by design, not subject to production test.

Specifications subject to change without notice.

ADG333A

ABSOLUTE MAXIMUM RATINGS¹

(T_A = +25°C unless otherwise noted)

V _{DD} to V _{SS}	+44 V
V _{DD} to GND	−0.3 V to +30 V
V _{SS} to GND	+0.3 V to −30 V
Analog, Digital Inputs ²	V _{SS} − 2 V to V _{DD} + 2 V or 20 mA, Whichever Occurs First
Continuous Current, S or D	20 mA
Peak Current, S or D	40 mA (Pulsed at 1 ms, 10% Duty Cycle Max)
Operating Temperature Range	
Industrial (B Version)	−40°C to +85°C
Storage Temperature Range	−65°C to +125°C
Junction Temperature	+150°C
Plastic Package	
θ _{JA} , Thermal Impedance	103°C/W
Lead Temperature, Soldering (10 sec)	+260°C

SOIC Package

θ _{JA} , Thermal Impedance	74°C/W
Lead Temperature, Soldering	
Vapor Phase (60 sec)	+215°C
Infrared (15 sec)	+220°C

SSOP Package

θ _{JA} , Thermal Impedance	130°C/W
Lead Temperature, Soldering	
Vapor Phase (60 sec)	+215°C
Infrared (15 sec)	+220°C

NOTES

¹Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Only one absolute maximum rating may be applied at any one time.

²Overvoltages at IN, S or D will be clamped by internal diodes. Current should be limited to the maximum ratings given.

CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the ADG333A features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



ORDERING GUIDE

Model	Temperature Range	Package Option*
ADG333ABN	−40°C to +85°C	N-20
ADG333ABR	−40°C to +85°C	R-20
ADG333ABRS	−40°C to +85°C	RS-20

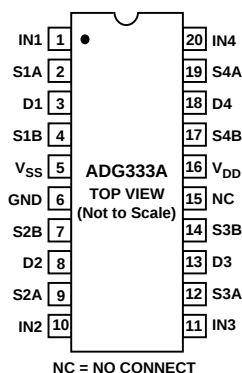
*N = Plastic DIP, R = Small Outline IC (SOIC), RS = Shrink Small Outline Package (SSOP).

Table I. Truth Table

Logic	Switch A	Switch B
0	OFF	ON
1	ON	OFF

TERMINOLOGY

S	Source Terminal. May be an input or output.	C_D, C_S (ON)	“ON” Switch Capacitance.
D	Drain Terminal. May be an input or output.	t_{ON}	Delay between applying the digital control input and the output switching on.
IN	Logic Control Input.	t_{OFF}	Delay between applying the digital control input and the output switching off.
R_{ON}	Ohmic resistance between D and S.	t_{OPEN}	Break Before Make delay when switches are configured as a multiplexer.
ΔR_{ON}	R_{ON} variation due to a change in the analog input voltage with a constant load current.	V_{INL}	Maximum input voltage for logic “0.”
R_{ON} Match	Difference between the R_{ON} of any two channels.	V_{INH}	Minimum input voltage for logic “1.”
I_S (OFF)	Source leakage current with the switch “OFF.”	I_{INL} (I_{INH})	Input current of the digital input.
I_D (OFF)	Drain leakage current with the switch “OFF.”	Crosstalk	A measure of unwanted signal which is coupled through from one channel to another as a result of parasitic capacitance.
I_D, I_S (ON)	Channel leakage current with the switch “ON.”	Off Isolation	A measure of unwanted signal coupling through an “OFF” switch.
V_D (V_S)	Analog voltage on terminals D, S.	Charge Injection	A measure of the glitch impulse transferred from the digital input to the analog output during switching.
C_S (OFF)	“OFF” Switch Source Capacitance.		
C_D (OFF)	“OFF” Switch Drain Capacitance.		

PIN CONFIGURATION**DIP/SOIC/SSOP**

ADG333A—Typical Performance Graphs

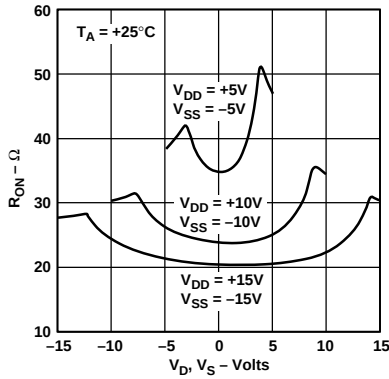


Figure 1. R_{ON} as a Function of V_D (V_S): Dual Supply

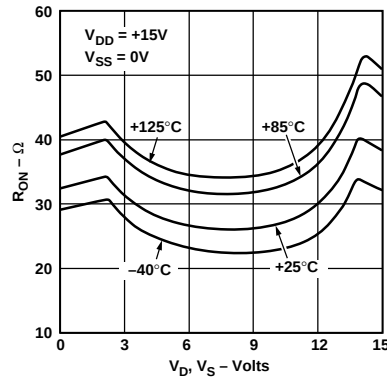


Figure 4. R_{ON} as a Function of V_D (V_S) for Different Temperatures: Single Supply

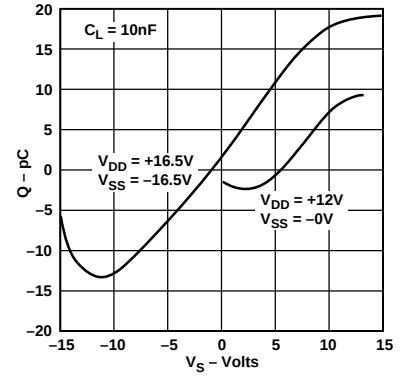


Figure 7. Charge Injection as a Function of V_S

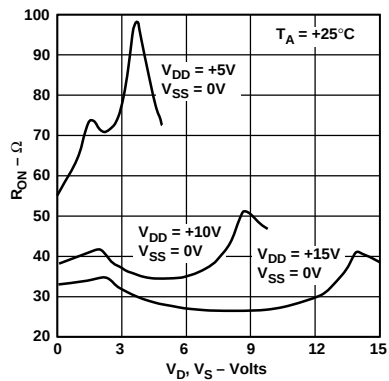


Figure 2. R_{ON} as a Function of V_D (V_S): Single Power Supply

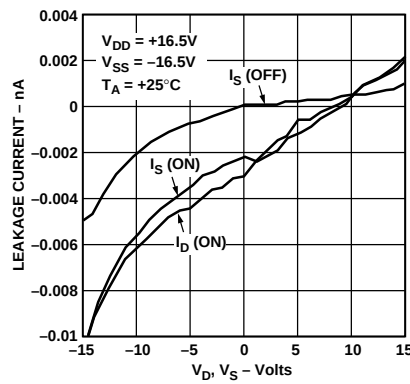


Figure 5. Leakage Currents as a Function of V_D (V_S): Dual Supply

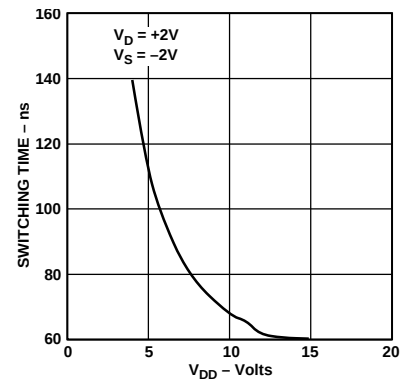


Figure 8. Switching Time as a Function of V_{DD}

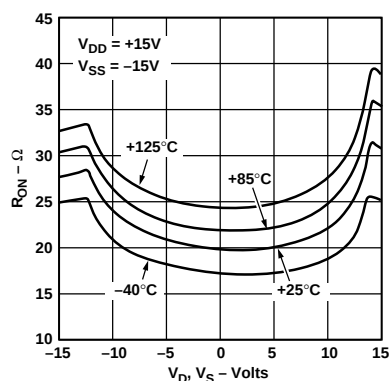


Figure 3. R_{ON} as a Function of V_D (V_S) for Different Temperatures: Dual Supply

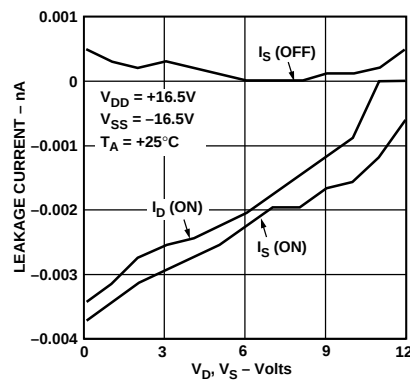


Figure 6. Leakage Currents as a Function of V_D (V_S): Single Supply

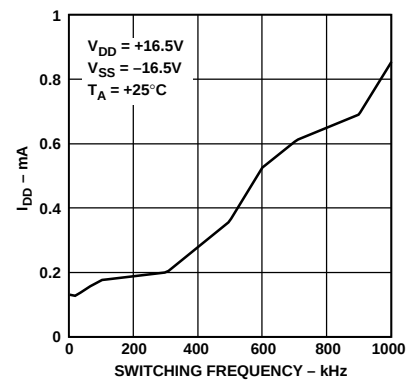
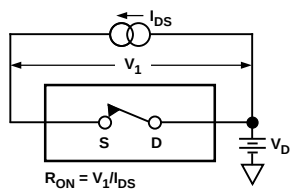
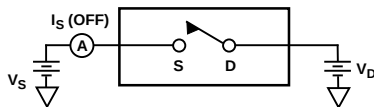


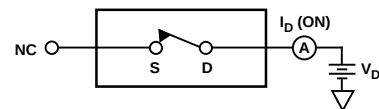
Figure 9. I_{DD} as a Function of Switching Frequency



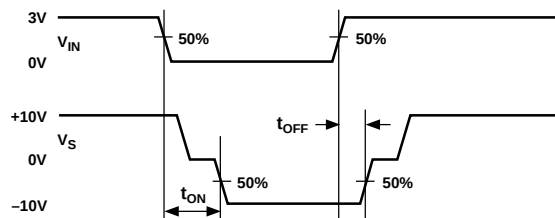
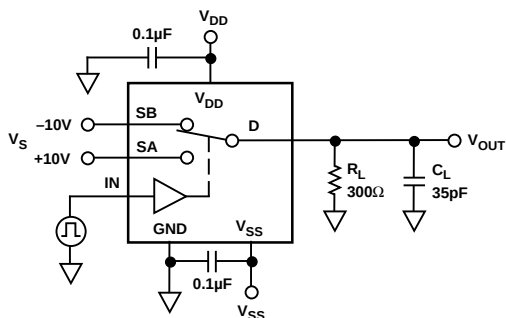
Test Circuit 1. On Resistance



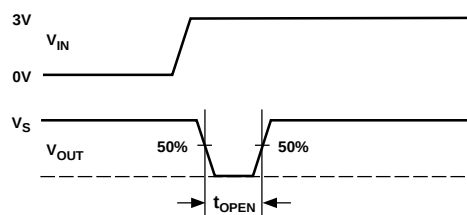
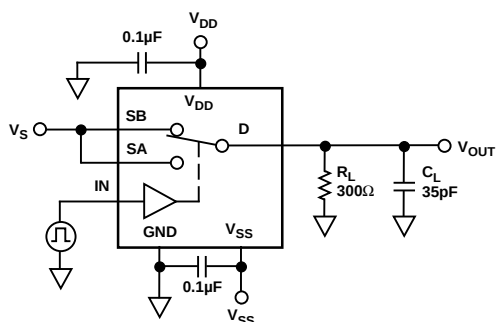
Test Circuit 2. Off Leakage



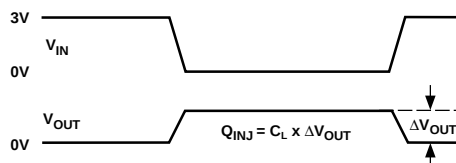
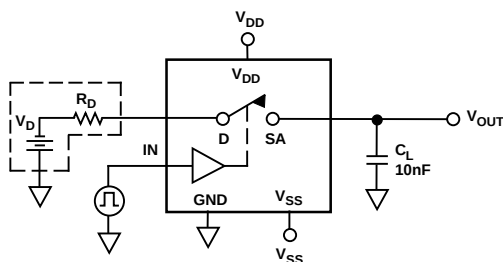
Test Circuit 3. On Leakage



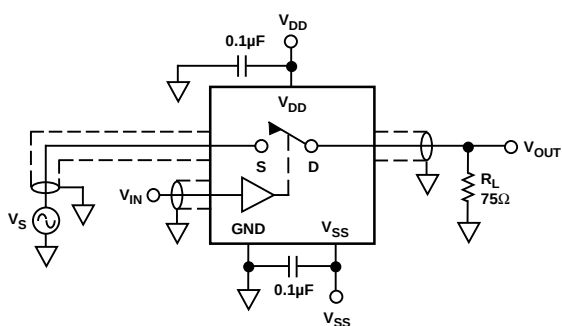
Test Circuit 4. Switching Times



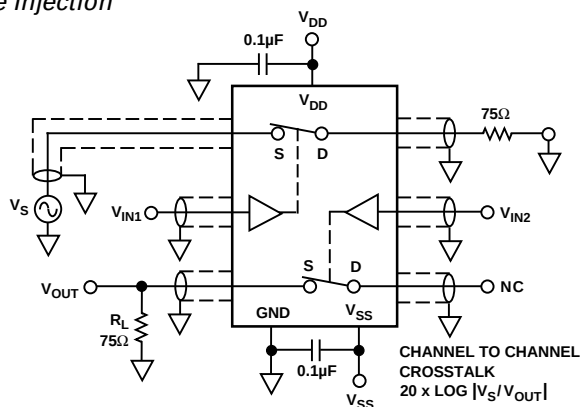
Test Circuit 5. Break-Before-Make Delay, t_{OPEN}



Test Circuit 6. Charge Injection



Test Circuit 7. Off Isolation



Test Circuit 8. Channel-to-Channel Crosstalk

