

## Precision Quad SPDT Analog Switch

### FEATURES

- $\pm 22$ -V Supply Voltage Range
- TTL and CMOS Compatible Logic
- Low On-Resistance (25  $\Omega$ )
- On-Resistance Matched Between Channels ( $<2 \Omega$ )
- Flat On-Resistance Over Analog Signal Range ( $\Delta <3 \Omega$ )
- Low Charge Injection (1 pC)
- Low Leakage (0.2 nA)
- Fast Switching (175 ns)
- Single-Supply Operation (5 V to 40 V)
- ESD tolerance  $>2$  kV per 3015.x
- Low Power ( $<1 \mu\text{A}$ ) – DG333A/333AL

### BENEFITS

- Rail-to-Rail Analog Signal Range
- Simple Logic Interface
- High Precision and Accuracy
- Minimal Transients
- Low Distortion
- Reduced Power Consumption
- Improved Reliability
- Break-Before-Make Switching Action

### APPLICATIONS

- Audio Switching
- Test Equipment
- Portable Instrumentation
- Communication Systems
- PBX, PABX
- Computer Peripherals
- Mass Storage Systems
- Switched-Capacitor Networks
- Battery-Powered Systems

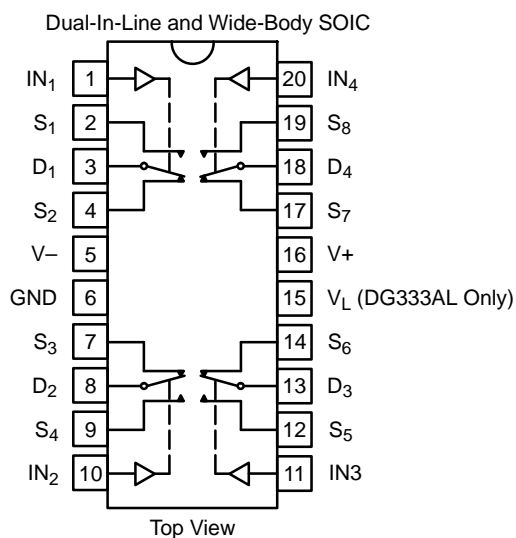
### DESCRIPTION

The DG333A/333AL consist of four independently controlled single-pole double-throw analog switches. These monolithic switch is designed to control analog signals with a high degree of accuracy. The DG333A/333AL minimize measurement errors by offering low on-resistance (25- $\Omega$  typ), low leakage (20-pA typ) and low charge injection performance. The DG333AL features micro-power operation ( $<1\text{-}\mu\text{W}$  typ). This is ideal for battery operated systems. Pin 15 is not connected on the DG333A.

An improved charge injection compensation design minimizes switching transients. These switches can handle up to  $\pm 22$ -V signals and have an improved continuous current of 30 mA.

The DG333A/333AL is fabricated in Vishay Siliconix's proprietary HVSG-2 CMOS process, resulting in higher speed and lower power consumption. An epitaxial layer prevents latchup. Each switch conducts equally well in both directions when on. When off, they block voltages up to the power-supply levels.

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



### TRUTH TABLE

Logic	SW1, 4, 5, 8 Normally Open	SW2, 3, 6, 7 Normally Closed
0	Off	On
1	On	Off

Logic "0"  $\leq 0.8$  V  
Logic "1"  $\geq 2.4$  V

### ORDERING INFORMATION

Temp Range	Package	Part Number
-40 to 85°C	20-Pin Plastic DIP	DG333ADJ
		DG333ALDJ
	20-Pin Wide-Body SOIC	DG333ADW
		DG333ALDW

### ABSOLUTE MAXIMUM RATINGS

Voltages Referenced to V-	
V+ .....	44 V
GND .....	30 V
V+ to GND .....	30 V
Digital Inputs <sup>a</sup> V <sub>S</sub> , V <sub>D</sub> .....	(V-) -2 V to (V+) +2 V or 30 mA, whichever occurs first
Current, Any Terminal .....	30 mA
Peak Current, S or D (Pulsed at 1 ms, 10% duty cycle max) .....	100 mA

Storage Temperature .....	-65 to 125°C
Power Dissipation (Package) <sup>b</sup>	
20-Pin Plastic DIP <sup>c</sup> .....	890 mW
20-Pin Wide SOIC <sup>d</sup> .....	800 mW

**Notes:**

- a. Signals on S<sub>X</sub>, D<sub>X</sub>, or IN<sub>X</sub> exceeding V+ or V- will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- b. All leads welded or soldered to PC Board.
- c. Derate 12 mW/°C above 75°C
- d. Derate 10 mW/°C above 75°C

### SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

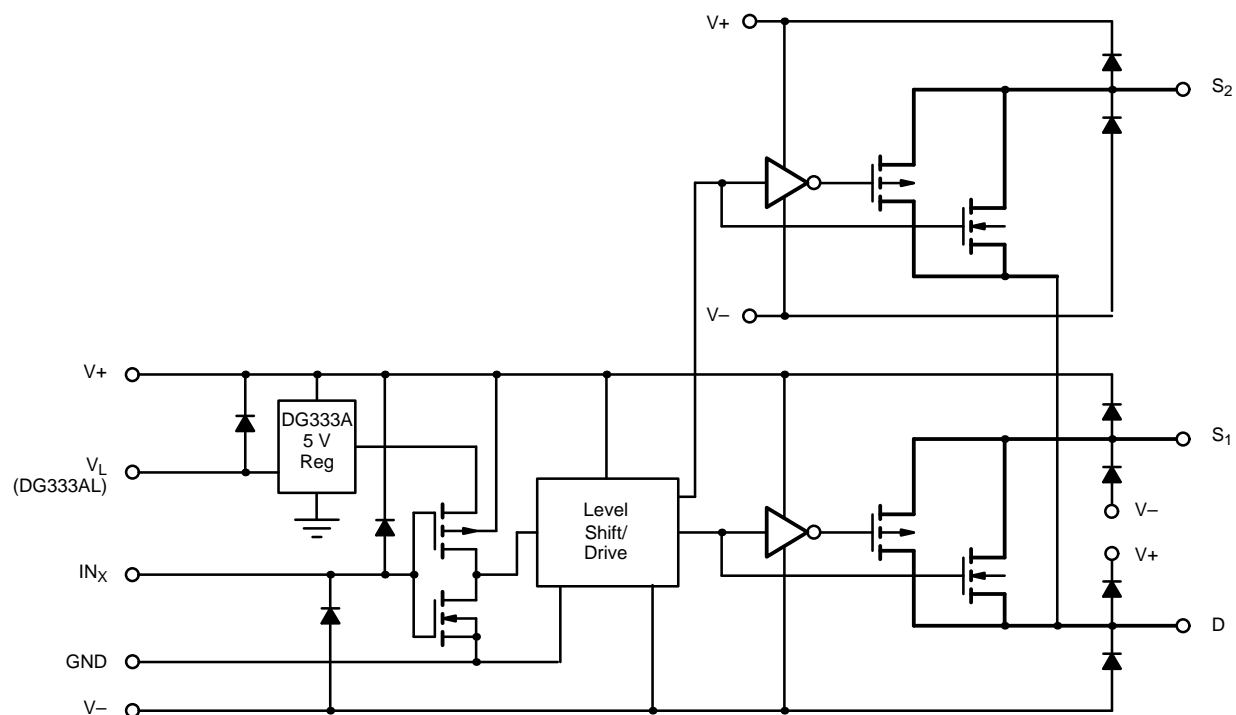


FIGURE 1.



SPECIFICATIONS							
Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_+ = 15\text{ V}, V_- = -15\text{ V}$ $V_{IN} = 2.4\text{ V}, 0.8\text{ V}^e$	Limits D Suffix -40 to 85°C				Unit
			Temp <sup>a</sup>	Min <sup>b</sup>	Typ <sup>c</sup>	Max <sup>b</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>d</sup>	$V_{ANALOG}$		Full	$V_-$		$V_+$	V
Channel On-Resistance	$r_{DS(on)}$	$I_S = -10\text{ mA}, V_D = \pm 10\text{ V}$	Room Full		25	45 90	$\Omega$
On-Resistance Flatness		$I_S = -10\text{ mA}, V_D = \pm 5\text{ V}$ $V_+ = 16.5\text{ V}, V_- = -16.5\text{ V}$	Room Full			3 5	
$r_{DS(on)}$ Match Between Channels <sup>f</sup>		$I_S = -10\text{ mA}, V_D = \pm 10\text{ V}$	Room Full			2 4	
Source Off Leakage Current	$I_{S(off)}$	$V_D = \pm 15.5\text{ V}, V_S = \mp 15.5\text{ V}$ $V_+ = 16.5\text{ V}, V_- = -16.5\text{ V}$	Room Hot	-0.25 -20		0.25 20	nA
Channel On Leakage Current	$I_{D(on)}$	$V_D = \pm 15.5\text{ V}, V_{S(open)} = \mp 15.5\text{ V}$ $V_+ = 16.5\text{ V}, V_- = -16.5\text{ V}$	Room Hot	-0.75 -60		0.75 60	
<b>Digital Control</b>							
Input Voltage High	$V_{INH}$		Full	2.4			V
Input Voltage Low	$V_{INL}$		Full			0.8	
Input Current	$I_{INH}$ or $I_{INL}$	$V_{INH}$ or $V_{INL}$	Full	-1		1	$\mu\text{A}$
<b>Dynamic Characteristics</b>							
Turn-On Time	$t_{ON}$	See Switching Time Test Circuit Figure 2	Room			175	ns
Turn-Off Time	$t_{OFF}$		Room			145	
Break-Before-Make Time Delay	$t_D$	See Figure 3	Room	5			
Charge Injection <sup>d</sup>	Q	$C_L = 10\text{ nF}, V_{gen} = 0\text{ V}, R_{gen} = 0\text{ }\Omega$	Room			10	pC
Off Isolation	OIRR	$R_L = 75\text{ }\Omega, C_L = 5\text{ pF}$ $V_D = 2.3\text{ V}_{RMS}, f = 1\text{ MHz}$	Room		72		dB
Channel-to-Channel Crosstalk	$X_{TALK}$		Room		80		
Off Capacitance	$C_{OFF}$	$f = 1\text{ MHz}, V_S = 0\text{ V}$	Room		8		pF
Channel On Capacitance	$C_{ON}$		Room		12		
<b>Power Supplies</b>							
Positive Supply Current	$I_+$	DG333A: $V_{IN} = 0$ or $5\text{ V}$	Room			200	$\mu\text{A}$
Negative Supply Current	$I_-$		Room	-1			
Positive Supply Current	$I_+$	DG333AL: $V_{IN} = 0$ or $5\text{ V}, V_L = 5\text{ V}$	Room			1	
Logic Supply Current	$I_L$		Room			1	
Negative Supply Current	$I_-$		Room	-1			
Supply Voltage Range	$V_+/V_-$		Full	$\pm 4$		$\pm 22$	

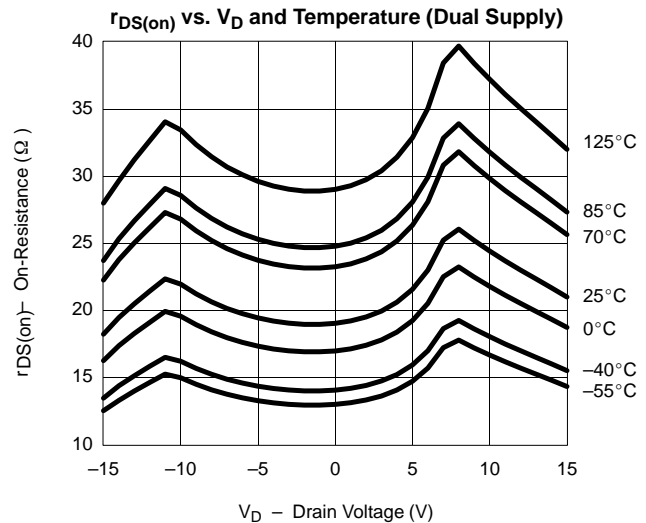
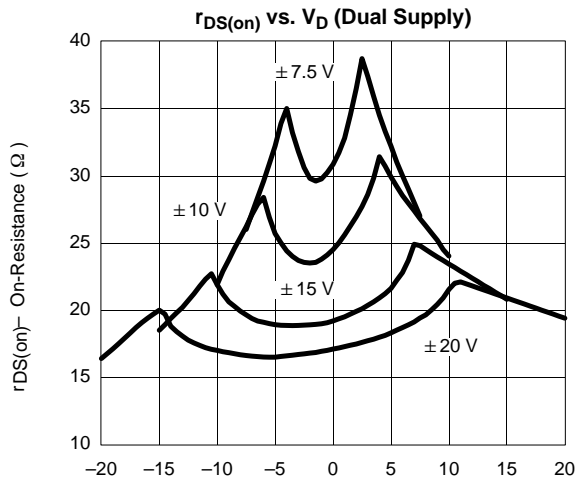


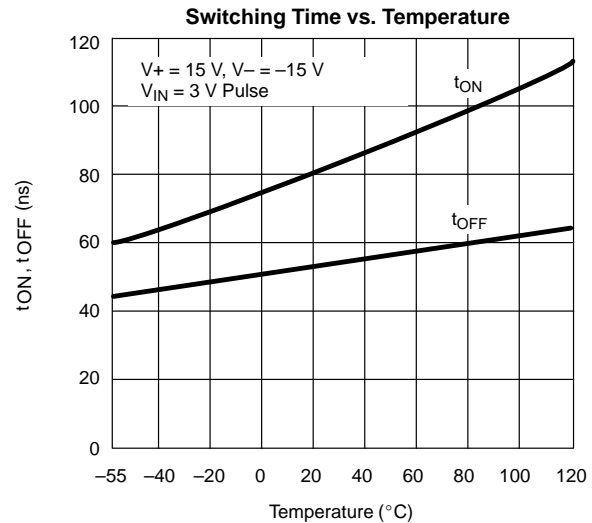
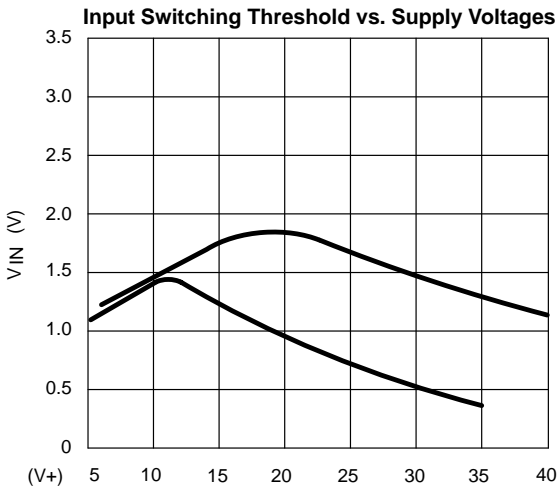
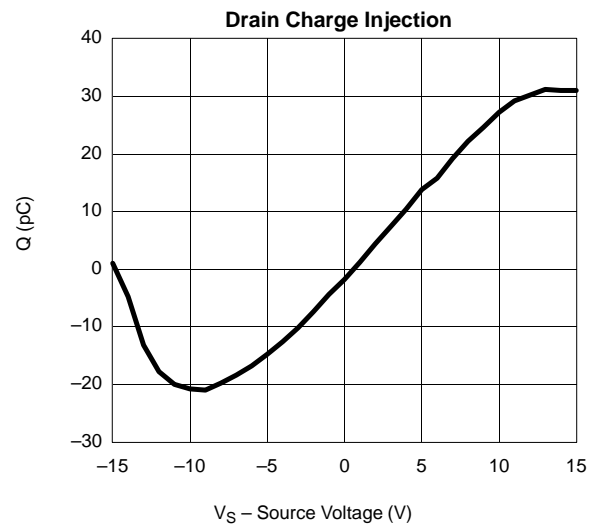
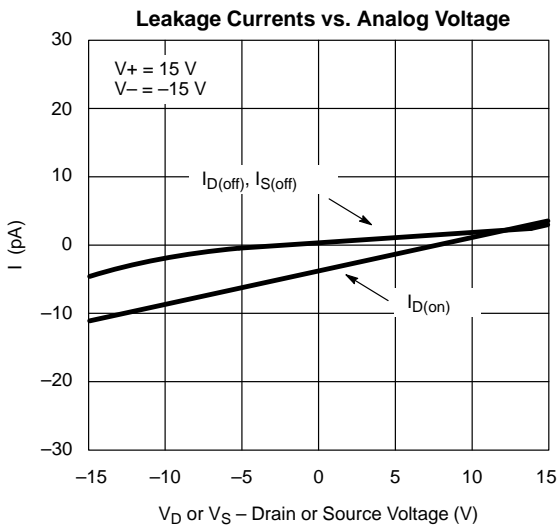
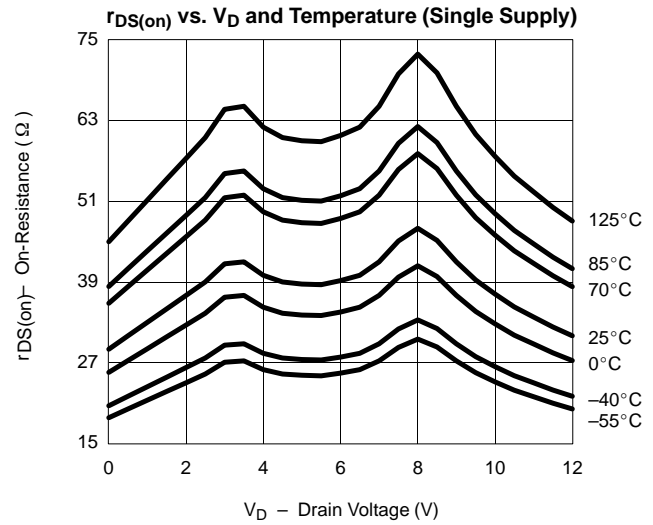
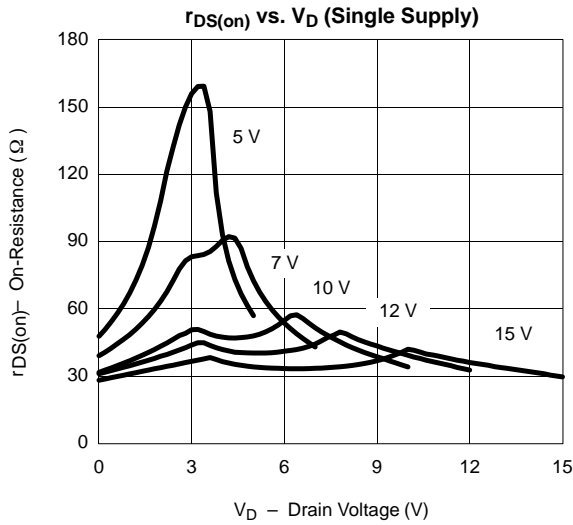
SPECIFICATIONS (UNIPOLAR SUPPLIES)							
Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_+ = 12\text{ V}, V_- = -0\text{ V}$ $T_A = 25^\circ\text{C}$	Limits D Suffix -40 to 85°C				Unit
			Temp <sup>a</sup>	Min <sup>b</sup>	Typ <sup>c</sup>	Max <sup>b</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>d</sup>	$V_{\text{ANALOG}}$		Full	$V_-$		$V_+$	V
Channel On-Resistance	$r_{\text{DS(on)}}$	$I_S = -10\text{ mA}, V_D = 10, 1\text{ V}$	Room		35	75	$\Omega$
Source Off Leakage Current	$I_{\text{S(off)}}$	$V_D = 11\text{ V}, V_{\text{S(open)}} = 1\text{ V}$	Room			0.25	nA
Channel On Leakage Current	$I_{\text{D(on)}}$	$V_D = 11\text{ V}, V_{\text{S(open)}} = 0\text{ V}$ $V_D = 1\text{ V}, V_{\text{S(open)}} = V_+$	Room			0.75	
<b>Dynamic Characteristics</b>							
Turn-On Time	$t_{\text{ON}}$	See Switching Times Test Circuit Figure 2	Room		90		ns
Turn-Off Time	$t_{\text{OFF}}$		Room		45		
Break-Before-Make Time Delay	$t_{\text{D}}$	See Figure 3	Room	5	10		
<b>Power Supplies</b>							
Positive Supply Current	$I_+$	DG333A: $V_{\text{IN}} = 0$ or $5\text{ V}$	Room			200	$\mu\text{A}$
			Room			1	
Positive Supply Current	$I_+$	DG333AL: $V_{\text{IN}} = 0$ or $5\text{ V}, V_L = 5\text{ V}$	Room			1	
Logic Supply Current	$I_L$		Room			1	
Positive Supply Range	$V_+$		Room	5		40	V

**Notes:**

- Room = 25°C, Full = as determined by the operating temperature suffix.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- Guaranteed by design, not subject to production test.
- $V_{\text{IN}}$  = input voltage to perform proper function.
- On-resistance match and flatness are guaranteed only for bipolar supply operation.

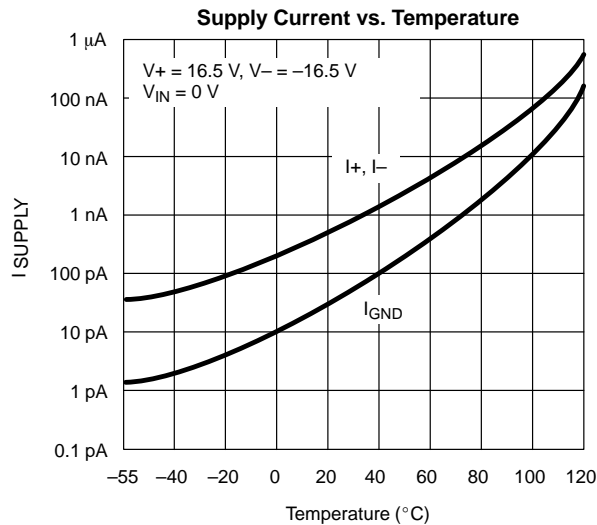
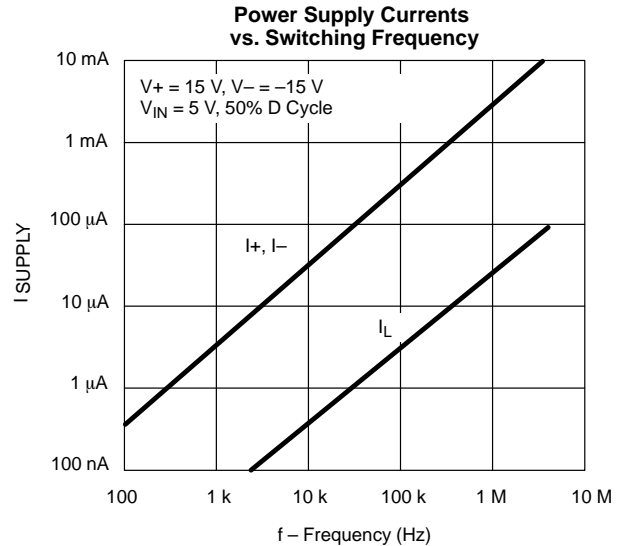
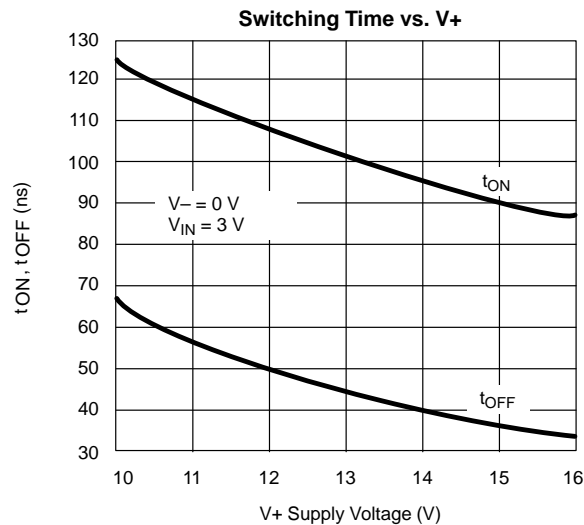
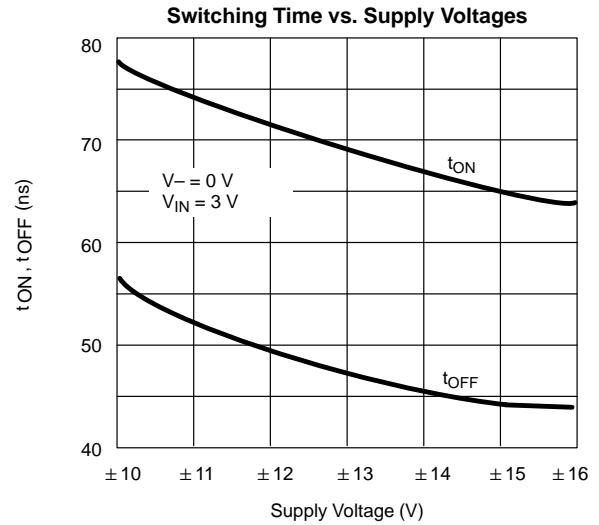
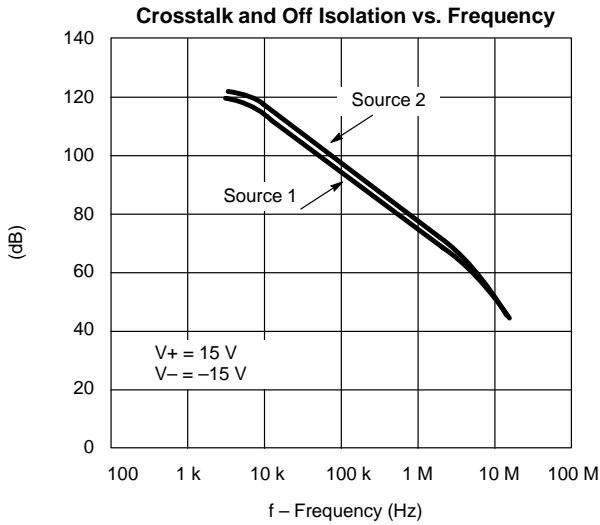
### TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

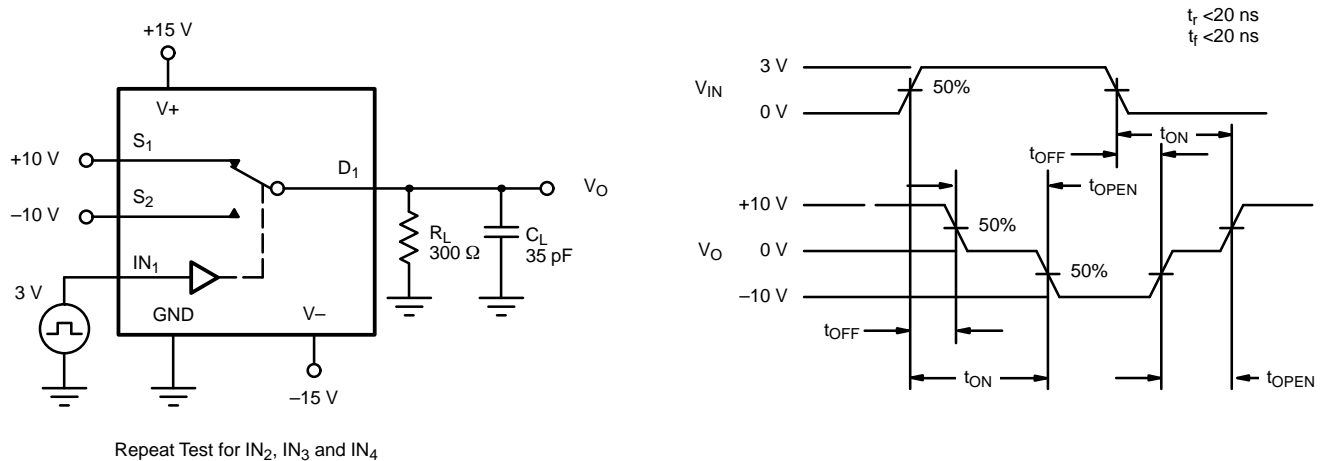
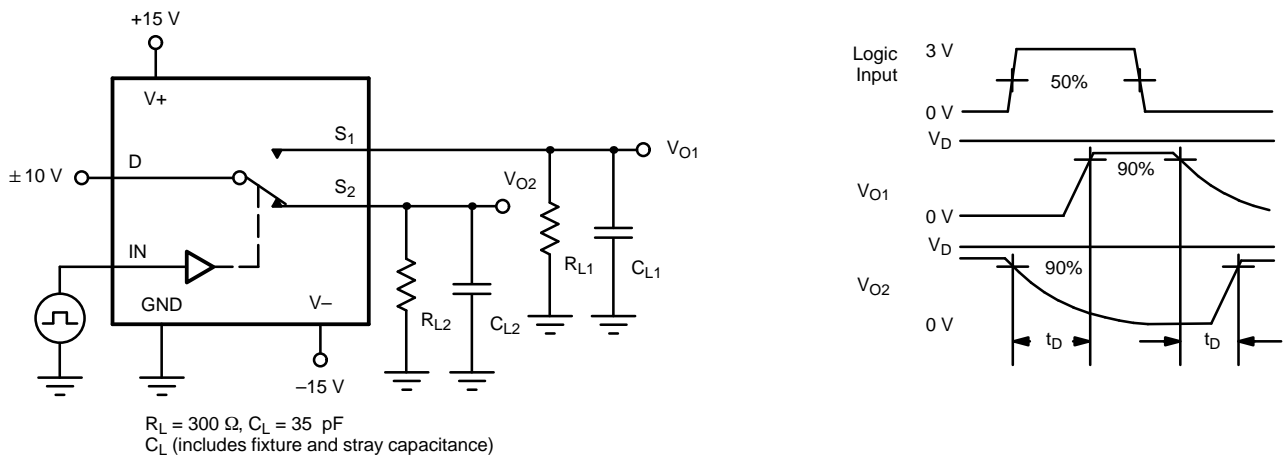
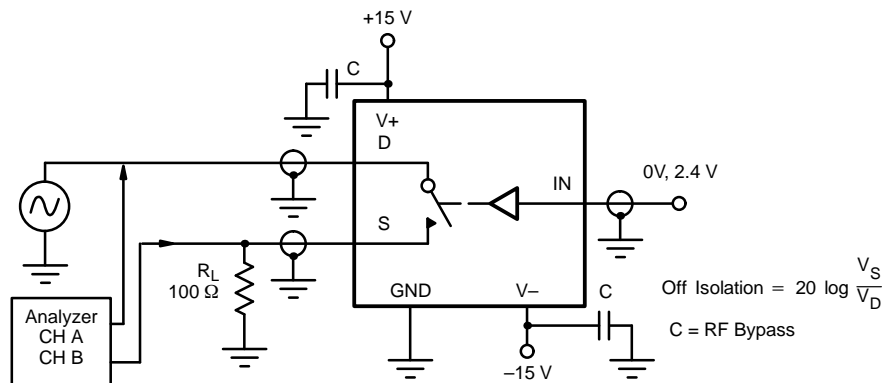


**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**




**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**



**TEST CIRCUITS**

**FIGURE 2. Switching Times**

**FIGURE 3. Break-Before-Make**

**FIGURE 4. Off Isolation**

TEST CIRCUITS

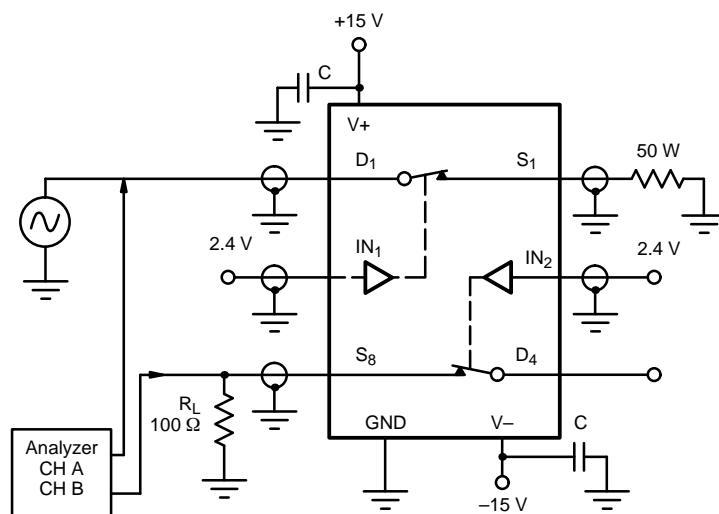


FIGURE 5. Crosstalk

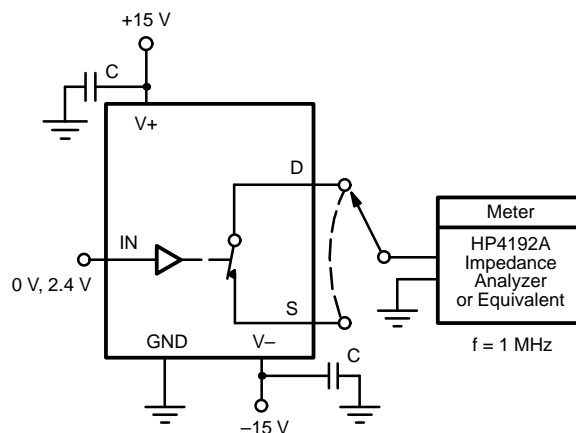


FIGURE 6. Capacitances

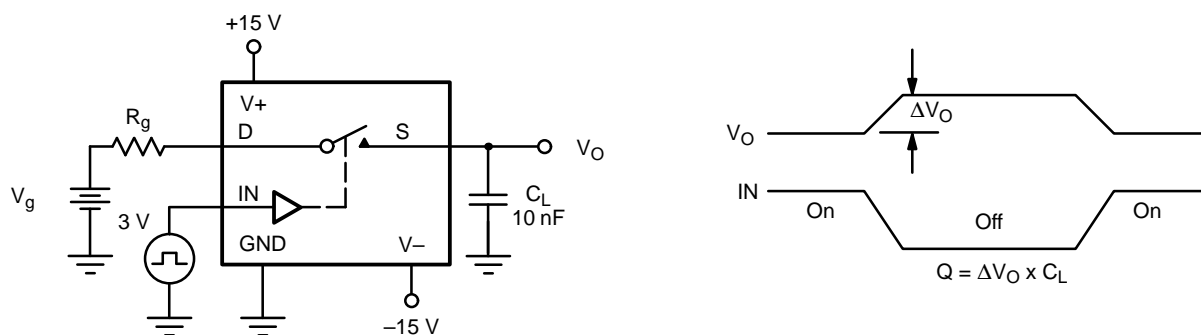


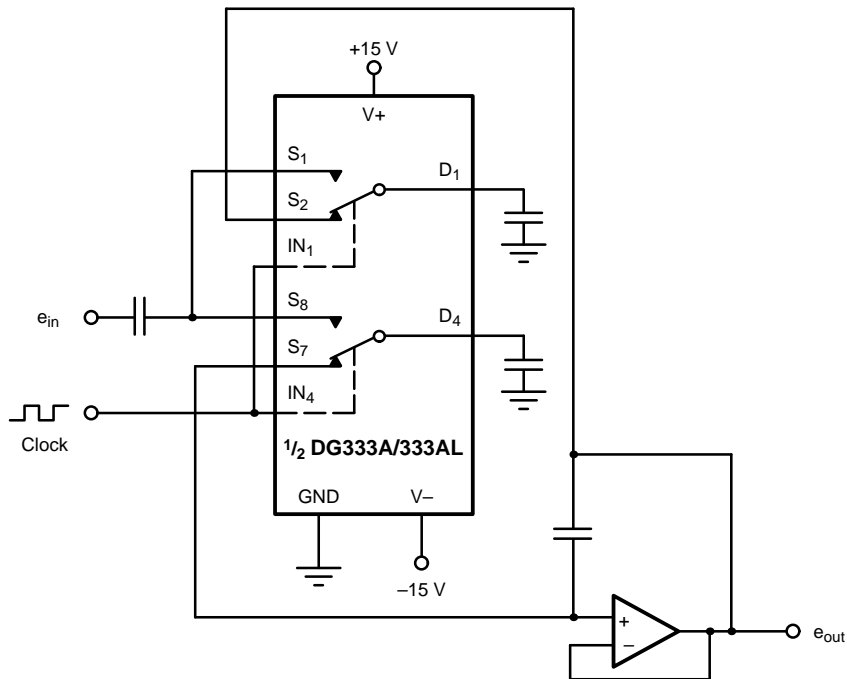
FIGURE 7. Charge Injection



**APPLICATIONS**
**Band-Pass Switched Capacitor Filter**

Single-pole double-throw switches are a common element for switched capacitor networks and filters. The fast switching times and low leakage of the DG333A/333AL allow for higher

clock rates and consequently higher filter operating frequencies. Figure 8 shows two capacitors being switched. The DG333A/333AL is capable of switching four capacitors.



**FIGURE 8.** Band-Pass Switched Capacitor Filter