

## Improved Quad CMOS Analog Switches

### FEATURES

- $\pm 22$ -V Supply Voltage Rating
- CMOS Compatible Logic
- Low On-Resistance— $r_{DS(on)}$ : 45  $\Omega$
- Low Leakage— $I_{D(on)}$ : 20 pA
- Single Supply Operation Possible
- Extended Temperature Range
- Fast Switching— $t_{ON}$ : < 200 ns
- Low Glitching—Q: 1 pC

### BENEFITS

- Wide Analog Signal Range
- Simple Logic Interface
- Higher Accuracy
- Minimum Transients
- Reduced Power Consumption
- Superior to DG308A/309
- Space Savings (TSSOP)

### APPLICATIONS

- Industrial Instrumentation
- Test Equipment
- Communications Systems
- Disk Drives
- Computer Peripherals
- Portable Instruments
- Sample-and-Hold Circuits

### DESCRIPTION

The DG308B/309B analog switches are highly improved versions of the industry-standard DG308A/309. These devices are fabricated in Vishay Siliconix' proprietary silicon gate CMOS process, resulting in lower on-resistance, lower leakage, higher speed, and lower power consumption.

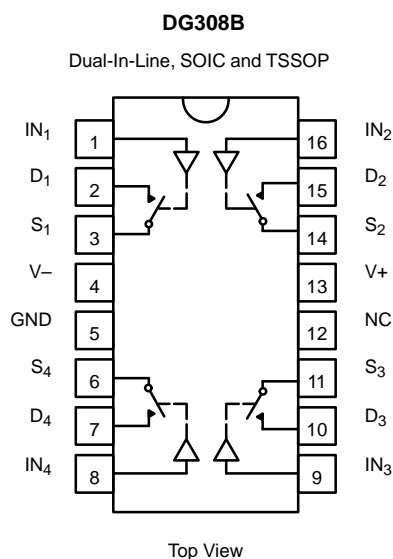
These quad single-pole single-throw switches are designed for a wide variety of applications in telecommunications, instrumentation, process control, computer peripherals, etc. An improved charge injection compensation design minimizes

switching transients. The DG308B and DG309B can handle up to  $\pm 22$ -V input signals. An epitaxial layer prevents latchup.

All devices feature true bi-directional performance in the on condition, and will block signals to the supply levels in the off condition.

The DG308B is a normally open switch and the DG309B is a normally closed switch. (See Truth Table.)

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



### TRUTH TABLE

Logic	DG308B	DG309B
0	OFF	ON
1	ON	OFF

Logic "0"  $\leq 3.5$ V  
Logic "1"  $\geq 11$  V

### ORDERING INFORMATION

Temp Range	Package	Part Number
-40 to 85°C	16-Pin Plastic DIP	DG308BDJ
		DG309BDJ
	16-Pin Narrow SOIC	DG308BDY
		DG309BDY
	16-Pin TSSOP	DG308BDQ
		DG309BDQ
-55 to 125°C	16-Pin CerDIP	DG308BAK
		DG308BAK/883
		DG309BAK
		DG309BAK/883



### ABSOLUTE MAXIMUM RATINGS

Voltages Referenced to V-

V+ .....	44 V
GND .....	25 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 (AK, Suffix) .....	-65 to 150°C
(DJ, DY, DQ Suffix) .....	-65 to 125°C

Power Dissipation (Package)<sup>b</sup>

16-Pin Plastic DIP <sup>c</sup> .....	470 mW
16-Pin Narrow SOIC and TSSOP <sup>d</sup> .....	640 mW
16-Pin CerDIP <sup>e</sup> .....	900 mW

Notes:

- Signals on S<sub>X</sub>, D<sub>X</sub>, or I<sub>NX</sub> exceeding V+ or V- will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- All leads welded or soldered to PC Board.
- Derate 6.5 mW/°C above 75°C
- Derate 7.6 mW/°C above 75°C
- Derate 12 mW/°C above 75°C

SPECIFICATIONS <sup>a</sup>									
Parameter	Symbol	Test Conditions Unless Specified V+ = 15 V, V- = -15 V V <sub>IN</sub> = 11 V, 3.5 V <sup>f</sup>	Temp <sup>b</sup>	Typ <sup>c</sup>	A Suffix -55 to 125°C		D Suffix -40 to 85°C		Unit
					Min <sup>d</sup>	Max <sup>d</sup>	Min <sup>d</sup>	Max <sup>d</sup>	
<b>Analog Switch</b>									
Analog Signal Range <sup>e</sup>	V <sub>ANALOG</sub>		Full		-15	15	-15	15	V
Drain-Source On-Resistance	r <sub>DS(on)</sub>	V <sub>D</sub> = ±10 V, I <sub>S</sub> = 1 mA	Room	45		85		85	Ω
			Full			100		100	
r <sub>DS(on)</sub> Match	Δr <sub>DS(on)</sub>		Room	2					%
Source Off Leakage Current	I <sub>S(off)</sub>	V <sub>S</sub> = ±14 V, V <sub>D</sub> = ∓14 V	Room	±0.01	-0.5	0.5	-0.5	0.5	nA
			Full		-20	20	-5	5	
Drain Off Leakage Current	I <sub>D(off)</sub>	V <sub>D</sub> = ±14 V, V <sub>S</sub> = ∓14 V	Room	±0.01	-0.5	0.5	-0.5	0.5	
			Full		-20	20	-5	5	
Drain On Leakage Current	I <sub>D(on)</sub>	V <sub>S</sub> = V <sub>D</sub> = ±14 V	Room	±0.02	-0.5	0.5	-0.5	0.5	nA
			Full		-40	40	-10	10	
<b>Digital Control</b>									
Input Voltage High	V <sub>INH</sub>		Full		11		11		V
Input Voltage Low	V <sub>INL</sub>		Full			3.5		3.5	
Input Current	I <sub>INH</sub> or I <sub>INL</sub>	V <sub>INH</sub> or V <sub>INL</sub>	Full		-1	1	-1	1	μA
Input Capacitance	C <sub>IN</sub>		Room	5					pF
<b>Dynamic Characteristics</b>									
Turn-On Time	t <sub>ON</sub>	V <sub>S</sub> = 3 V, See Figure 2	Room			200		200	ns
Turn-Off Time	t <sub>OFF</sub>		Room			150		150	
Charge Injection	Q	C <sub>L</sub> = 1000 pF, V <sub>g</sub> = 0 V, R <sub>g</sub> = 0 Ω	Room	1					pC
Source-Off Capacitance	C <sub>S(off)</sub>	V <sub>S</sub> = 0 V, f = 1 MHz	Room	5					pF
Drain-Off Capacitance	C <sub>D(off)</sub>		Room	5					
Channel On Capacitance	C <sub>D(on)</sub>	V <sub>D</sub> = V <sub>S</sub> = 0 V, f = 1 MHz	Room	16					
Off Isolation	OIRR	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 50 Ω V <sub>S</sub> = 1 V <sub>RMS</sub> , f = 100 kHz	Room	90					dB
Channel-to-Channel Crosstalk	X <sub>TALK</sub>		Room	95					



SPECIFICATIONS <sup>a</sup>									
Parameter	Symbol	Test Conditions Unless Specified $V_+ = 15\text{ V}, V_- = -15\text{ V}$ $V_{IN} = 11\text{ V}, 3.5\text{ V}^f$	Temp <sup>b</sup>	Typ <sup>c</sup>	A Suffix -55 to 125°C		D Suffix -40 to 85°C		Unit
					Min <sup>d</sup>	Max <sup>d</sup>	Min <sup>d</sup>	Max <sup>d</sup>	
<b>Power Supply</b>									
Positive Supply Current	I+	$V_{IN} = 0\text{ or }15\text{ V}$	Room Full			1 5		1 5	$\mu\text{A}$
Negative Supply Current	I-		Room Full		-1 -5		-1 -5		
Power Supply Range for Continuous Operation	V <sub>OP</sub>		Full		±4	±22	±4	±22	V

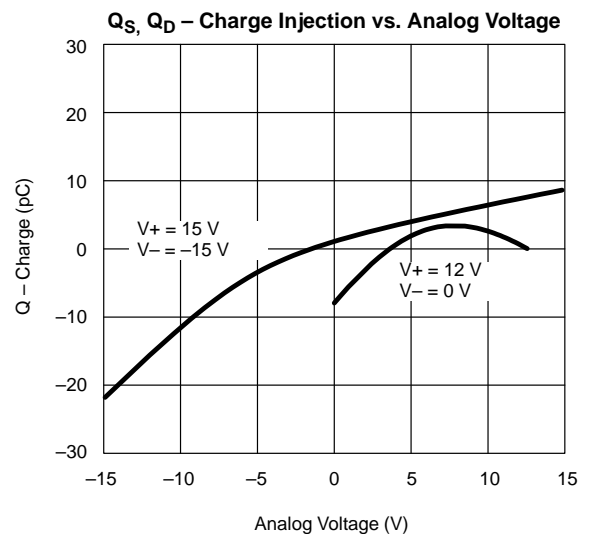
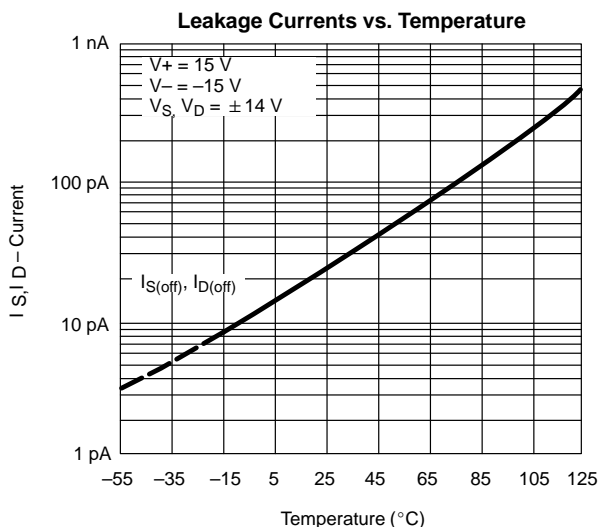
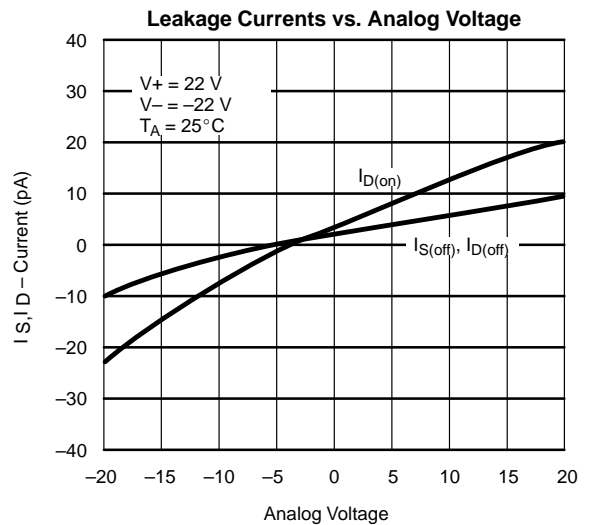
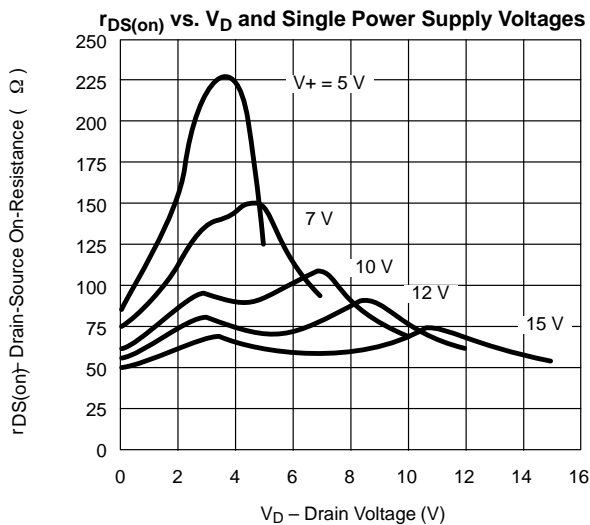
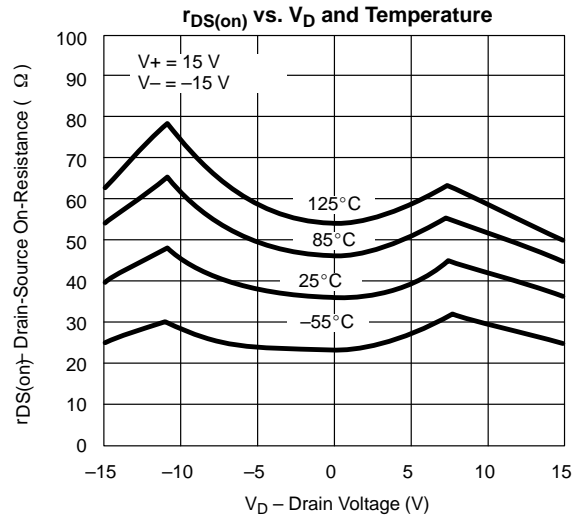
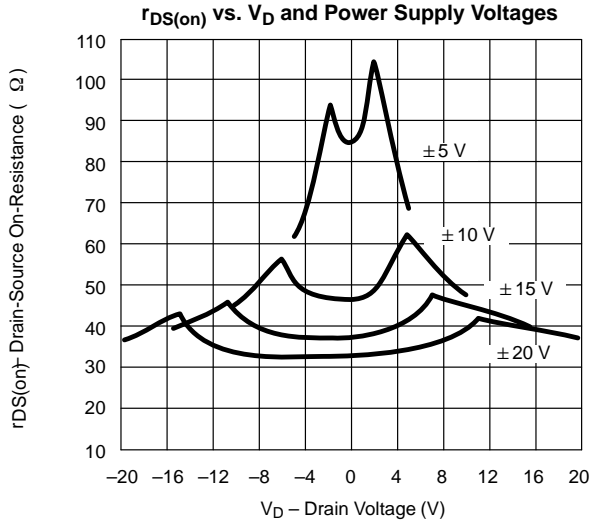
SPECIFICATIONS <sup>a</sup> FOR SINGLE SUPPLY									
Parameter	Symbol	Test Conditions Unless Specified $V_+ = 12\text{ V}, V_- = 0\text{ V}$ $V_{IN} = 11\text{ V}, 3.5\text{ V}^f$	Temp <sup>b</sup>	Typ <sup>c</sup>	A Suffix -55 to 125°C		D Suffix -40 to 85°C		Unit
					Min <sup>d</sup>	Max <sup>d</sup>	Min <sup>d</sup>	Max <sup>d</sup>	
<b>Analog Switch</b>									
Analog Signal Range <sup>e</sup>	V <sub>ANALOG</sub>		Full		0	12	0	12	V
Drain-Source On-Resistance	r <sub>DS(on)</sub>	$V_D = 3\text{ V}, 8\text{ V}, I_S = 1\text{ mA}$	Room Full	90		160 200		160 200	$\Omega$
<b>Dynamic Characteristics</b>									
Turn-On Time	t <sub>ON</sub>	$V_S = 8\text{ V}, \text{ See Figure 2}$	Room			300		300	ns
Turn-Off Time	t <sub>OFF</sub>		Room			200		200	
Charge Injection	Q	$C_L = 1\text{ nF}, V_{\text{gen}} = 6\text{ V}, R_{\text{gen}} = 0\ \Omega$	Room	4					pC
<b>Power Supply</b>									
Positive Supply Current	I+	$V_{IN} = 0\text{ or }12\text{ V}$	Room Full			1 5		1 5	$\mu\text{A}$
Negative Supply Current	I-		Room Full		-1 -5		-1 -5		
Power Supply Range for Continuous Operation	V <sub>OP</sub>		Full		4	44	4	44	V

Notes:

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



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



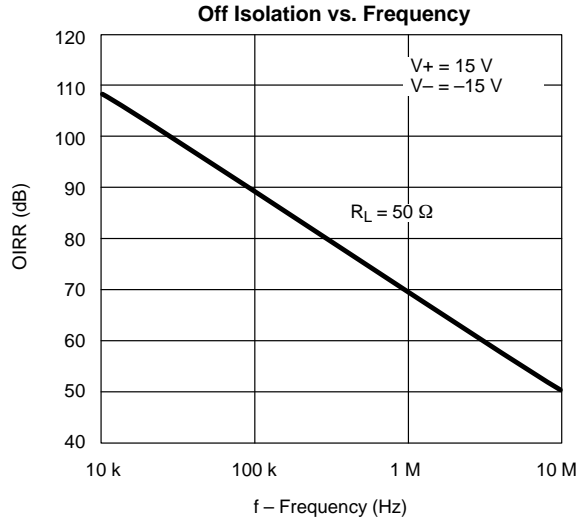
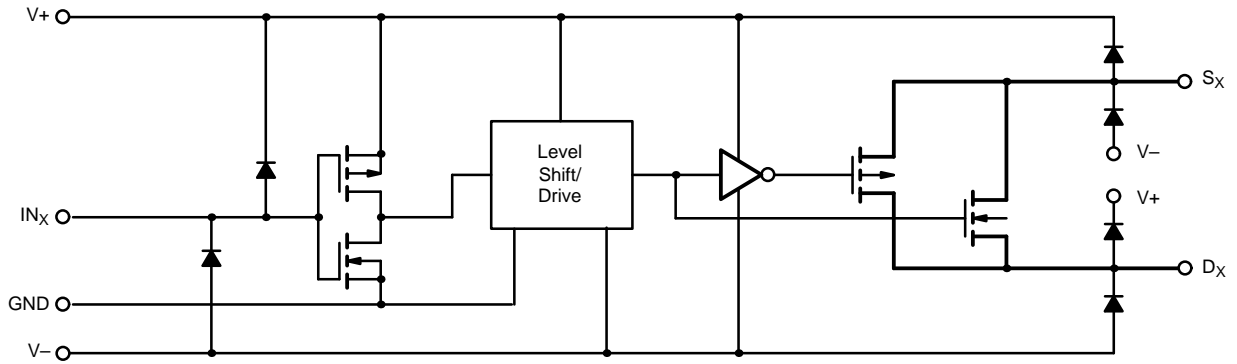
**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**

**SCHEMATIC DIAGRAM (TYPICAL CHANNEL)**


FIGURE 1.

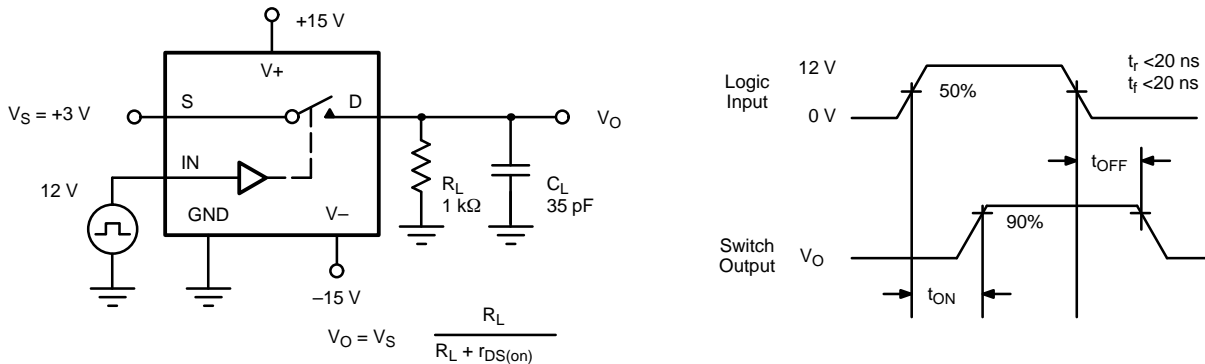
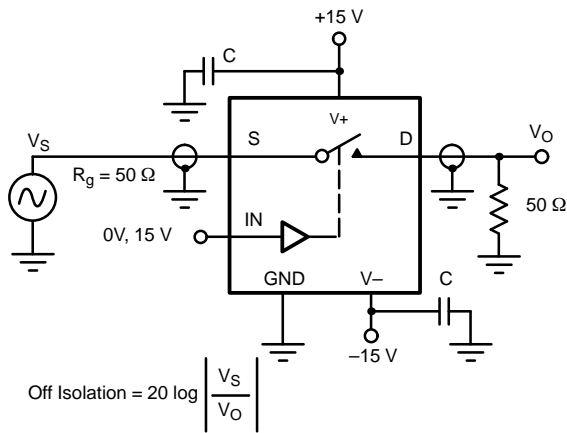
**TEST CIRCUITS**


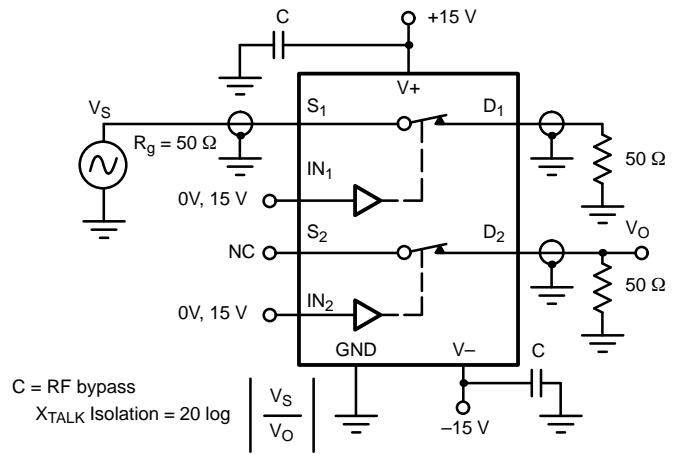
FIGURE 2. Switching Time

**TEST CIRCUITS**



$$\text{Off Isolation} = 20 \log \left| \frac{V_S}{V_O} \right|$$

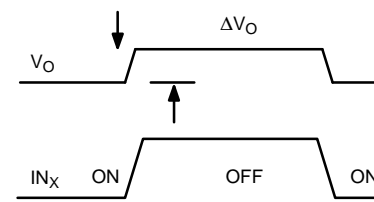
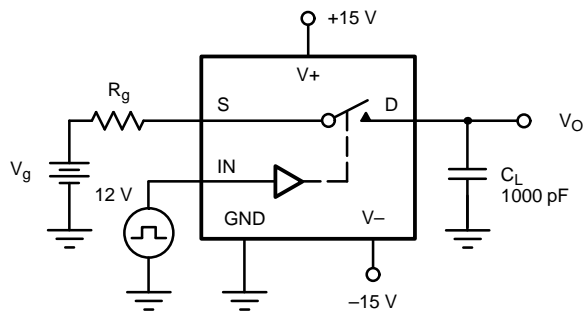
FIGURE 3. Off Isolation



C = RF bypass  

$$\text{XTALK Isolation} = 20 \log \left| \frac{V_S}{V_O} \right|$$

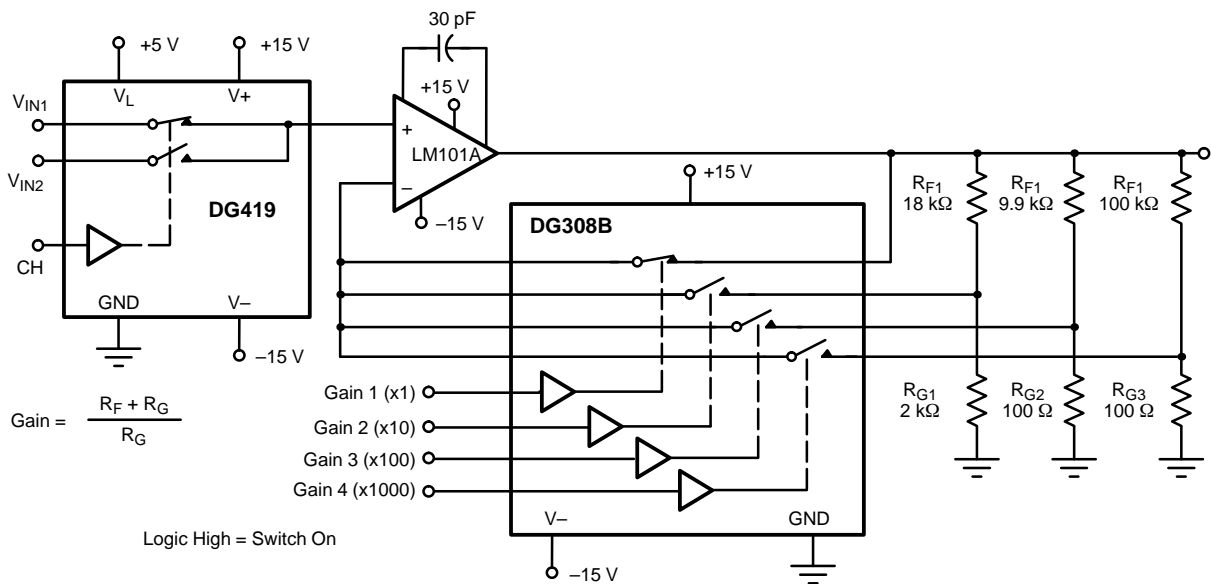
FIGURE 4. Channel-to-Channel Crosstalk



$\Delta V_O$  = measured voltage error due to charge injection  
 The charge injection in coulombs is  $Q = C_L \times \Delta V_O$

FIGURE 5. Charge Injection

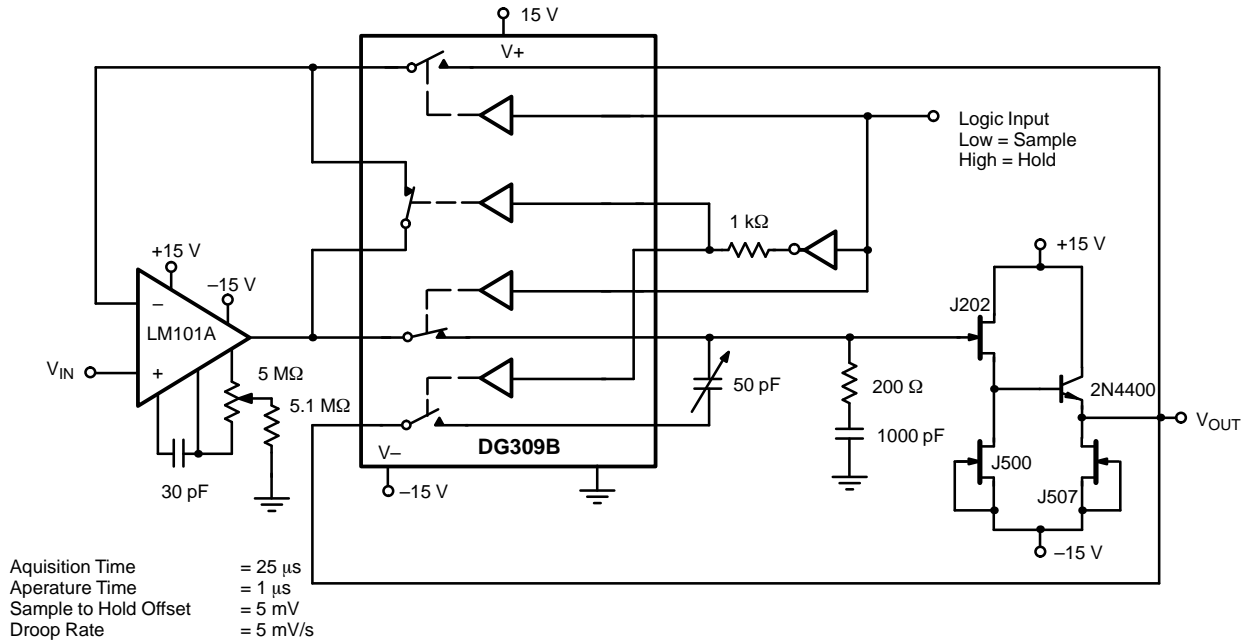
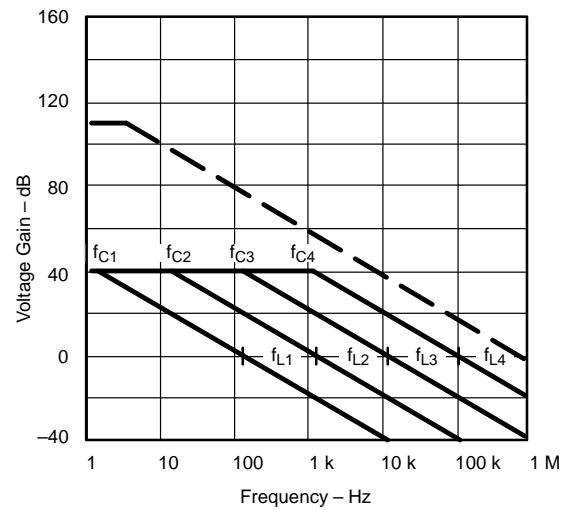
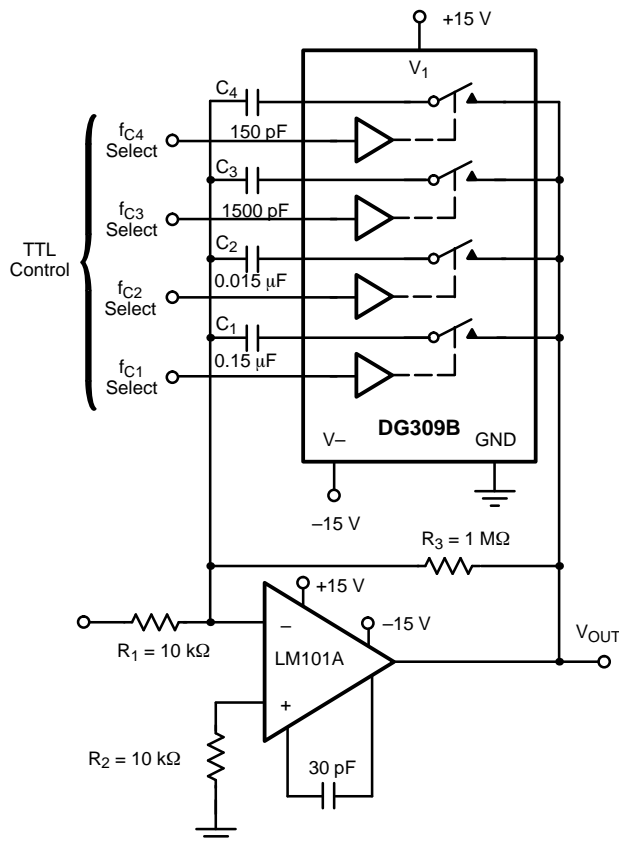
**APPLICATIONS**



$$\text{Gain} = \frac{R_F + R_G}{R_G}$$

Logic High = Switch On

FIGURE 6. A Precision Amplifier with Digitally Programmable Inputs and Gains

**APPLICATIONS**

**FIGURE 7. Sample-and-Hold**


$$A_L \text{ (Voltage Gain Below Break Frequency)} = \frac{R_3}{R_1} = 100 \text{ (40 dB)}$$

$$f_C \text{ (Break Frequency)} = \frac{1}{2\pi R_3 C_X}$$

$$f_L \text{ (Unity Gain Frequency)} = \frac{1}{2\pi R_1 C_X}$$

$$\text{Max Attenuation} = \frac{r_{DS(on)}}{10 \text{ k}\Omega} \approx -40 \text{ dB}$$

**FIGURE 8. Active Low Pass Filter with Digitally Selected Break Frequency**