

Improved Quad CMOS Analog Switches

FEATURES

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

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.

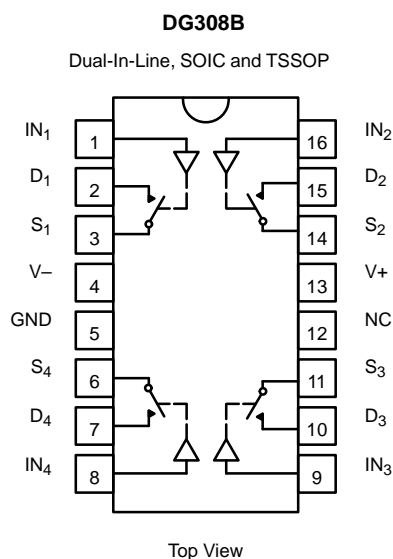
These quad single-pole single-throw switches are designed for a wide variety of applications in telecommunications, instrumentation, process control, computer peripherals, etc. An improved charge injection compensation design minimizes

switching transients. The DG308B and DG309B can handle up to $\pm 22\text{-V}$ 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" $\leq 3.5\text{V}$
Logic "1" $\geq 11\text{V}$

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 ^a V _S , V _D	(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)^b

16-Pin Plastic DIP ^c	470 mW
16-Pin Narrow SOIC and TSSOP ^d	640 mW
16-Pin CerDIP ^e	900 mW

Notes:

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



SPECIFICATIONS ^a									
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 ^b	Typ ^c	A Suffix -55 to 125°C		D Suffix -40 to 85°C		Unit
					Min ^d	Max ^d	Min ^d	Max ^d	
Power Supply									
Positive Supply Current	I+	$V_{IN} = 0\text{ or }15\text{ V}$	Room Full			1 5		1 5	μA
Negative Supply Current	I-		Room Full		-1 -5		-1 -5		
Power Supply Range for Continuous Operation	V _{OP}		Full		±4	±22	±4	±22	V

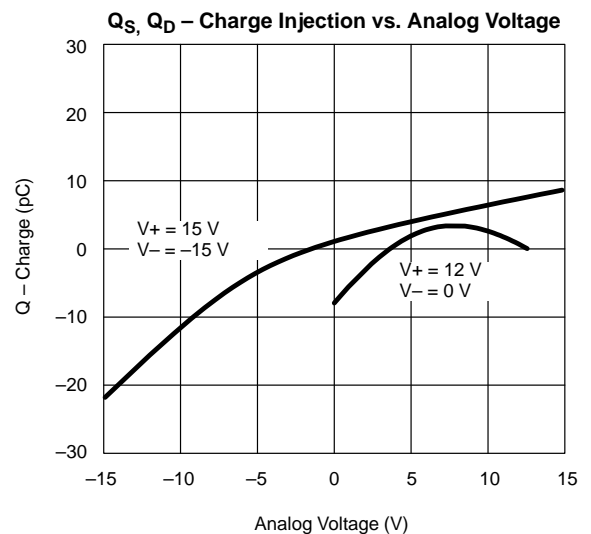
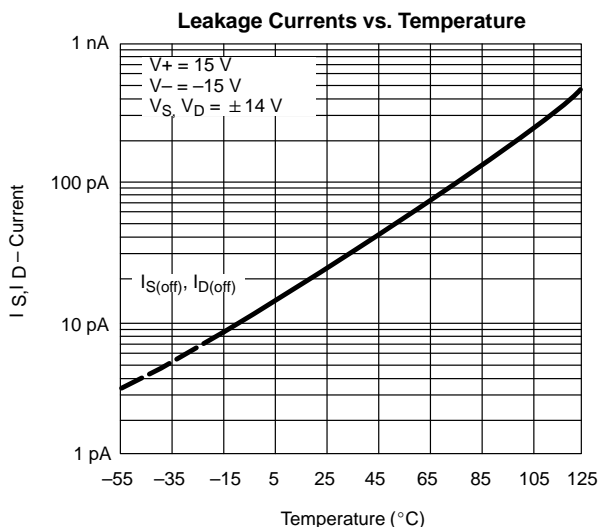
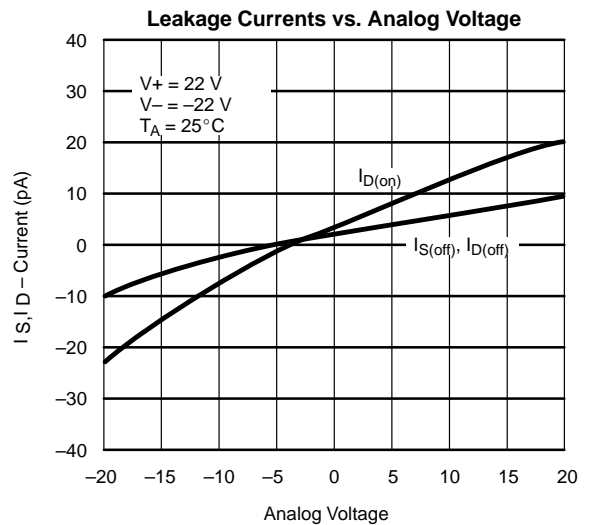
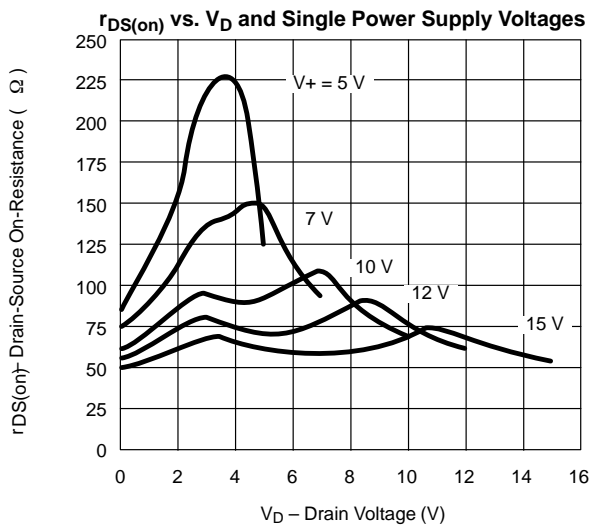
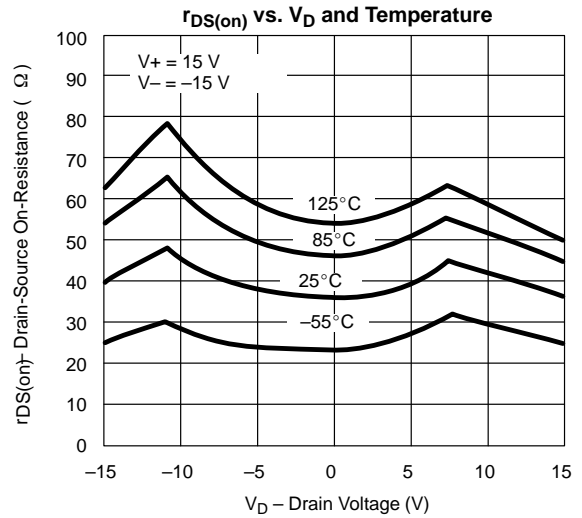
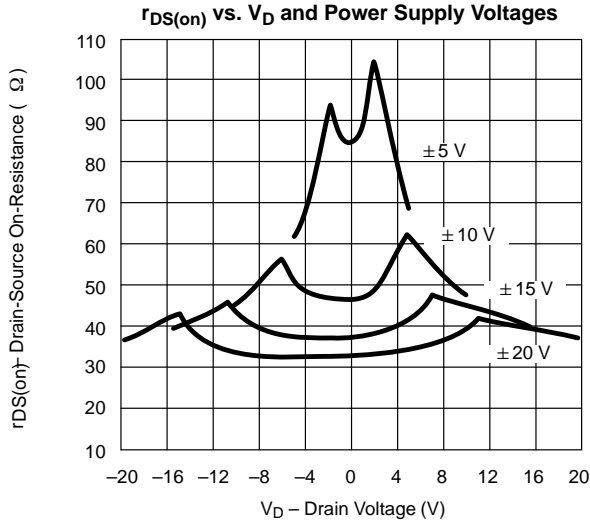
SPECIFICATIONS ^a FOR SINGLE SUPPLY									
Parameter	Symbol	Test Conditions Unless Specified $V_+ = 12\text{ V}, V_- = 0\text{ V}$ $V_{IN} = 11\text{ V}, 3.5\text{ V}^f$	Temp ^b	Typ ^c	A Suffix -55 to 125°C		D Suffix -40 to 85°C		Unit
					Min ^d	Max ^d	Min ^d	Max ^d	
Analog Switch									
Analog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

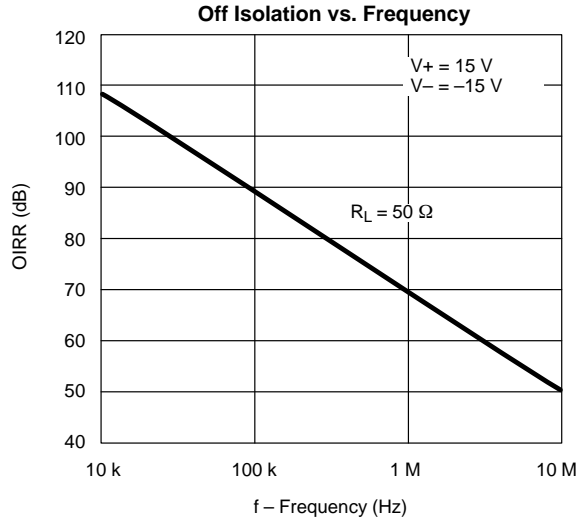
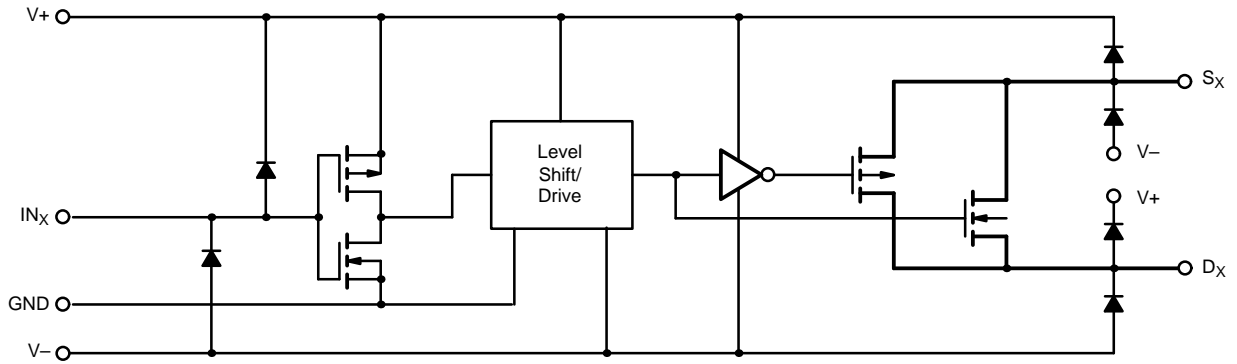
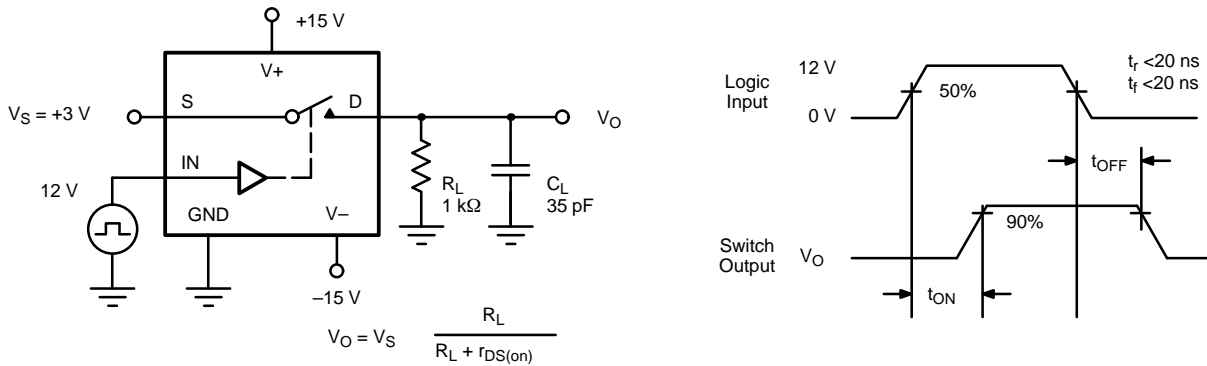
Notes:

- 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.

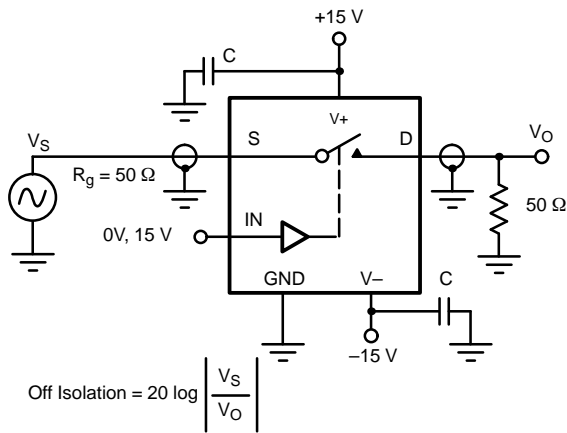


TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)



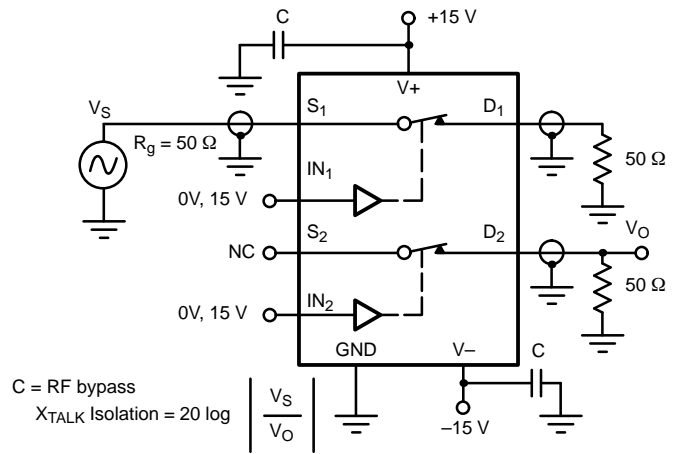
TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

FIGURE 1.
TEST CIRCUITS

FIGURE 2. Switching Time

TEST CIRCUITS



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

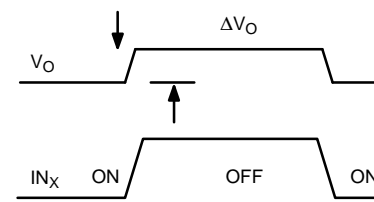
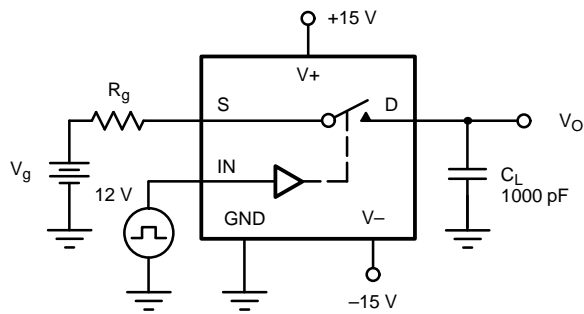
FIGURE 3. Off Isolation



C = RF bypass

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

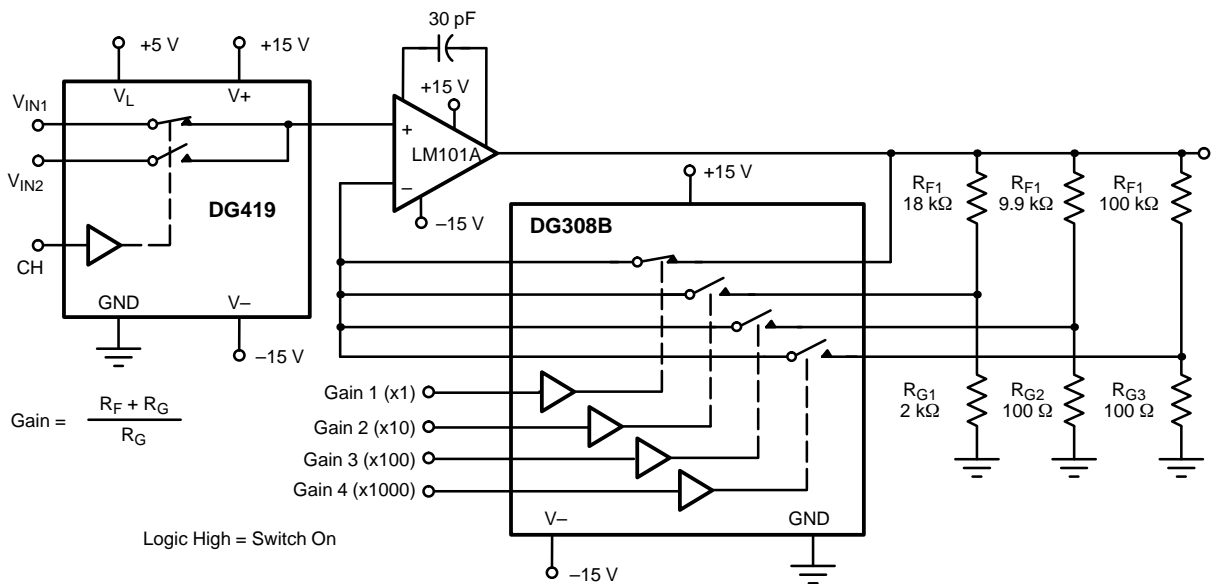
FIGURE 4. Channel-to-Channel Crosstalk



ΔV_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

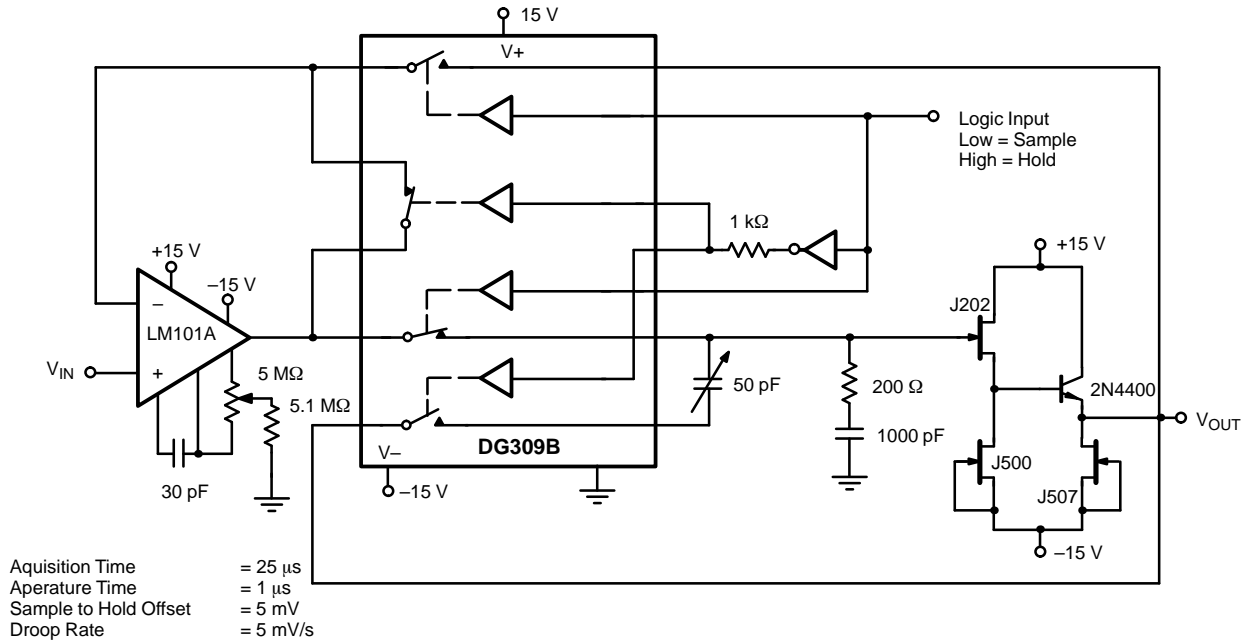
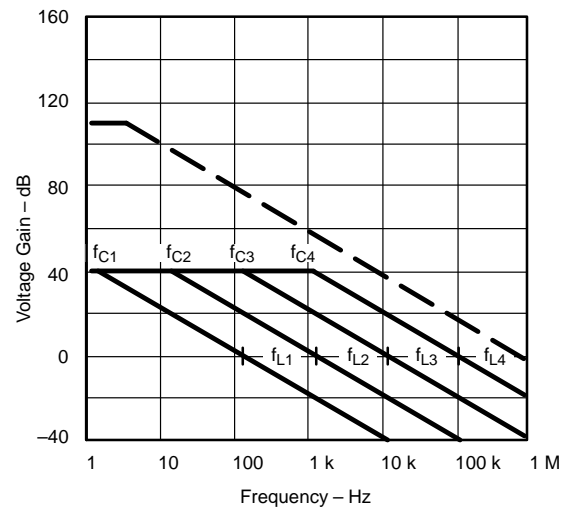
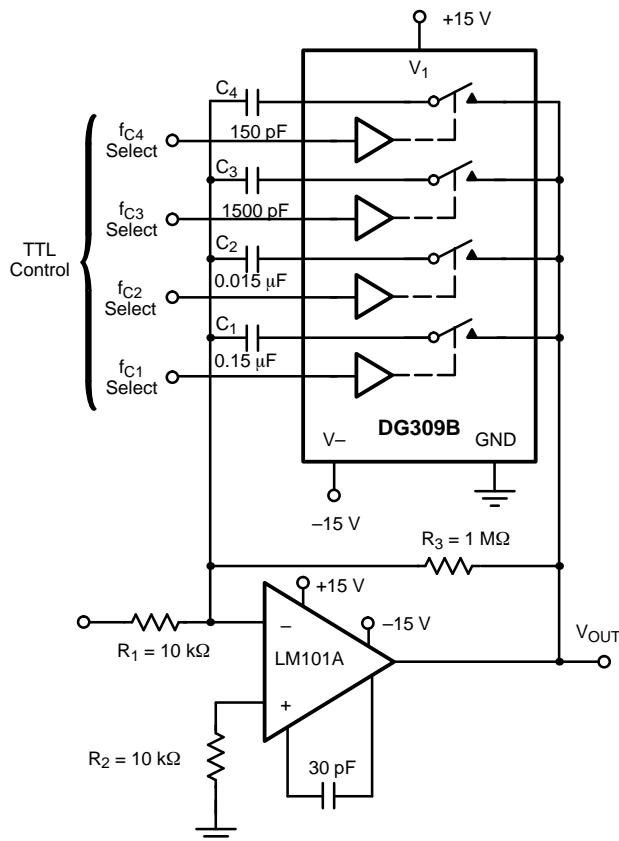
APPLICATIONS



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

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



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