



## 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— $I_{D(on)}$ :  $20\ \text{pA}$
- 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.

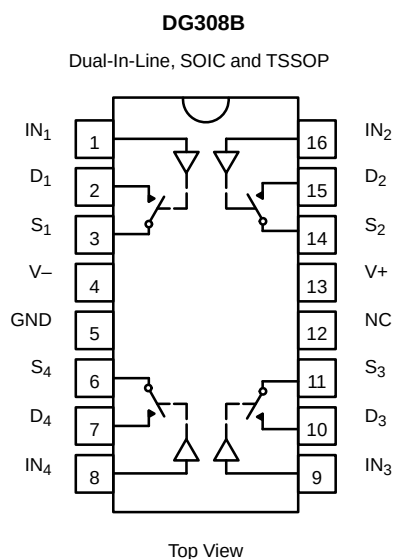
These quad single-pole single-throw switches are designed for a wide variety of applications in telecommunications, instrumentation, process control, computer peripherals, etc. An improved charge injection compensation design minimizes

switching transients. The DG308B and DG309B can handle up to  $\pm 22$ -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<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 mW16-Pin Narrow SOIC and TSSOP<sup>d</sup> ..... 640 mW16-Pin CerDIP<sup>e</sup> ..... 900 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 6.5 mW/°C above 75°C

d. Derate 7.6 mW/°C above 75°C

e. Derate 12 mW/°C above 75°C

SPECIFICATIONS<sup>a</sup>

| Parameter                        | Symbol                               | Test Conditions<br>Unless Specified<br>V <sub>+</sub> = 15 V, V <sub>–</sub> = –15 V<br>V <sub>IN</sub> = 11 V, 3.5 V <sup>f</sup> | Temp <sup>b</sup> | Typ <sup>c</sup> | A Suffix<br>–55 to 125°C |                  | D Suffix<br>–40 to 85°C |                  | Unit |
|----------------------------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------|--------------------------|------------------|-------------------------|------------------|------|
|                                  |                                      |                                                                                                                                    |                   |                  | Min <sup>d</sup>         | Max <sup>d</sup> | Min <sup>d</sup>        | Max <sup>d</sup> |      |
| Analog Switch                    |                                      |                                                                                                                                    |                   |                  |                          |                  |                         |                  |      |
| 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<br>Full      | 45               |                          | 85<br>100        |                         | 85<br>100        | Ω    |
| 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<br>Full      | ±0.01            | –0.5<br>–20              | 0.5<br>20        | –0.5<br>–5              | 0.5<br>5         | nA   |
| Drain Off Leakage Current        | I <sub>D(off)</sub>                  | V <sub>D</sub> = ±14 V, V <sub>S</sub> = ∓14 V                                                                                     | Room<br>Full      | ±0.01            | –0.5<br>–20              | 0.5<br>20        | –0.5<br>–5              | 0.5<br>5         |      |
| Drain On Leakage Current         | I <sub>D(on)</sub>                   | V <sub>S</sub> = V <sub>D</sub> = ±14 V                                                                                            | Room<br>Full      | ±0.02            | –0.5<br>–40              | 0.5<br>40        | –0.5<br>–10             | 0.5<br>10        |      |
| Digital Control                  |                                      |                                                                                                                                    |                   |                  |                          |                  |                         |                  |      |
| 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   |
| Dynamic Characteristics          |                                      |                                                                                                                                    |                   |                  |                          |                  |                         |                  |      |
| 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,<br>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<br>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<br>Unless Specified<br><br>V+ = 15 V, V– = –15 V<br>VIN = 11 V, 3.5 V <sup>f</sup> | Temp <sup>b</sup> | Typ <sup>c</sup> | A Suffix<br>–55 to 125°C |                  | D Suffix<br>–40 to 85°C |                  | Unit |
|---------------------------------------------|--------|----------------------------------------------------------------------------------------------------|-------------------|------------------|--------------------------|------------------|-------------------------|------------------|------|
|                                             |        |                                                                                                    |                   |                  | Min <sup>d</sup>         | Max <sup>d</sup> | Min <sup>d</sup>        | Max <sup>d</sup> |      |
| Power Supply                                |        |                                                                                                    |                   |                  |                          |                  |                         |                  |      |
| Positive Supply Current                     | I+     | VIN = 0 or 15 V                                                                                    | Room Full         |                  |                          | 1<br>5           |                         | 1<br>5           | µA   |
| Negative Supply Current                     | I–     |                                                                                                    | Room Full         |                  | –1<br>–5                 |                  | –1<br>–5                |                  |      |
| Power Supply Range for Continuous Operation | VOP    |                                                                                                    | Full              |                  | ± 4                      | ± 22             | ± 4                     | ± 22             | V    |

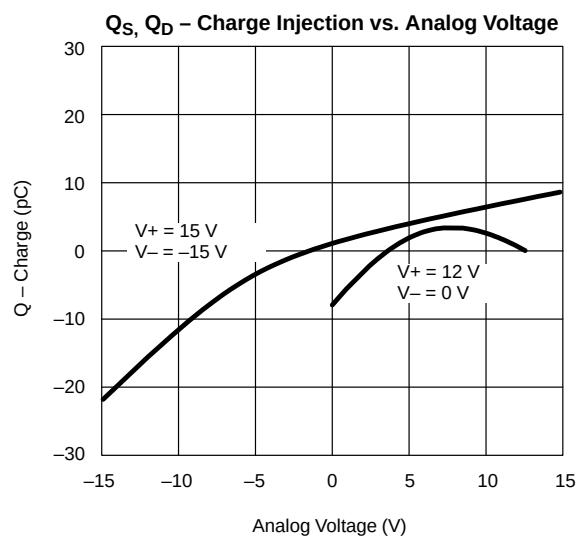
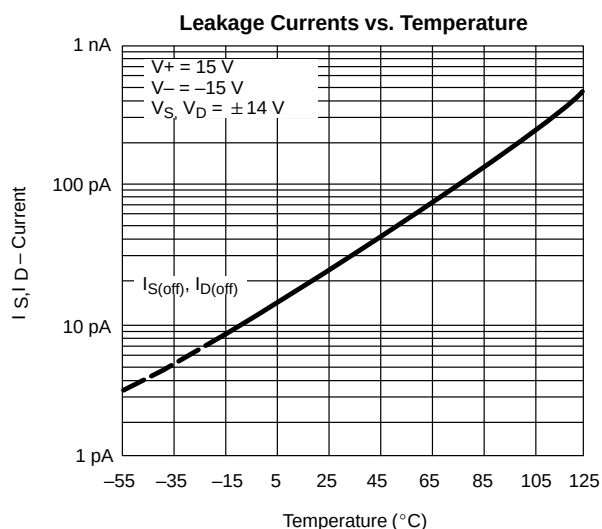
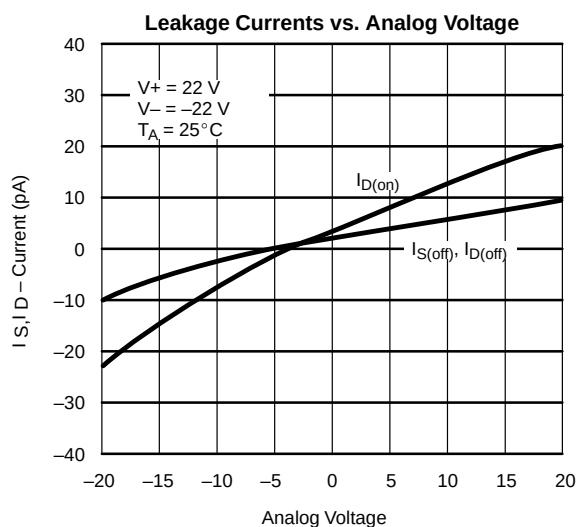
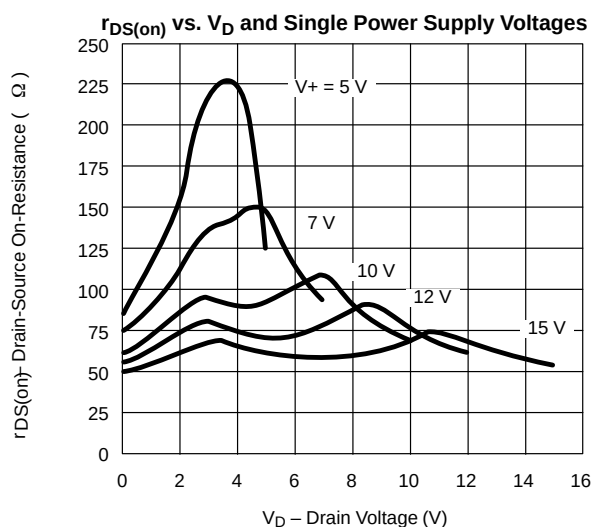
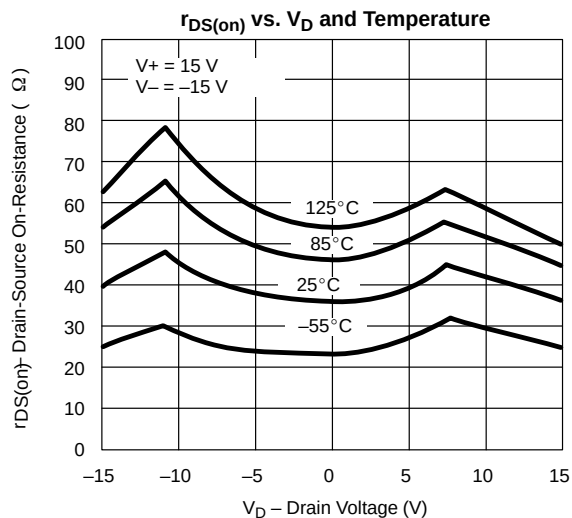
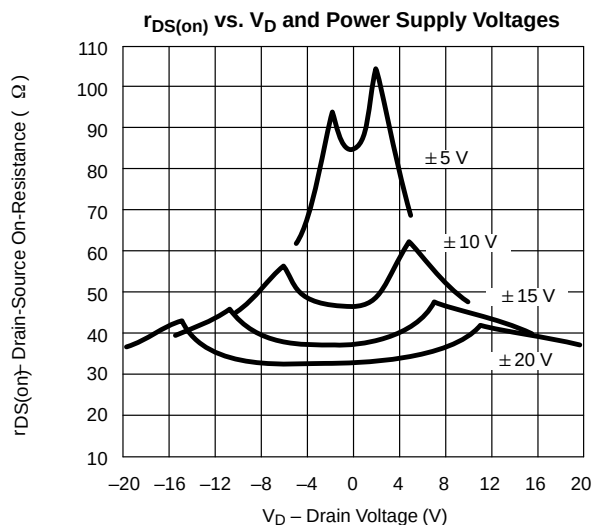
**SPECIFICATIONS<sup>a</sup> FOR SINGLE SUPPLY**

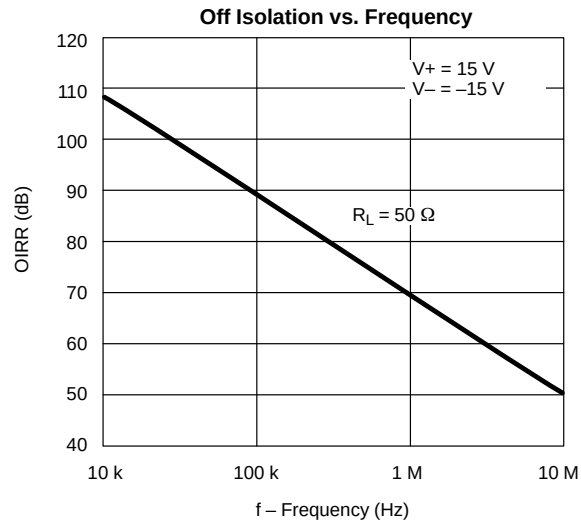
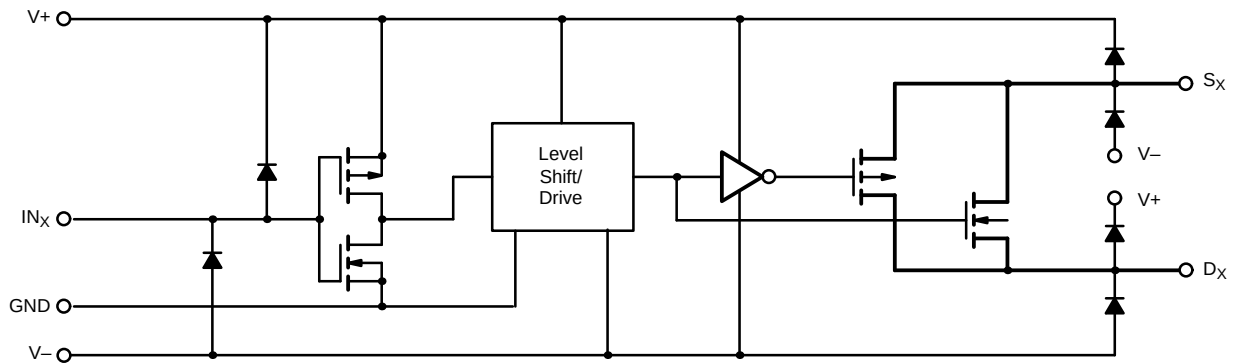
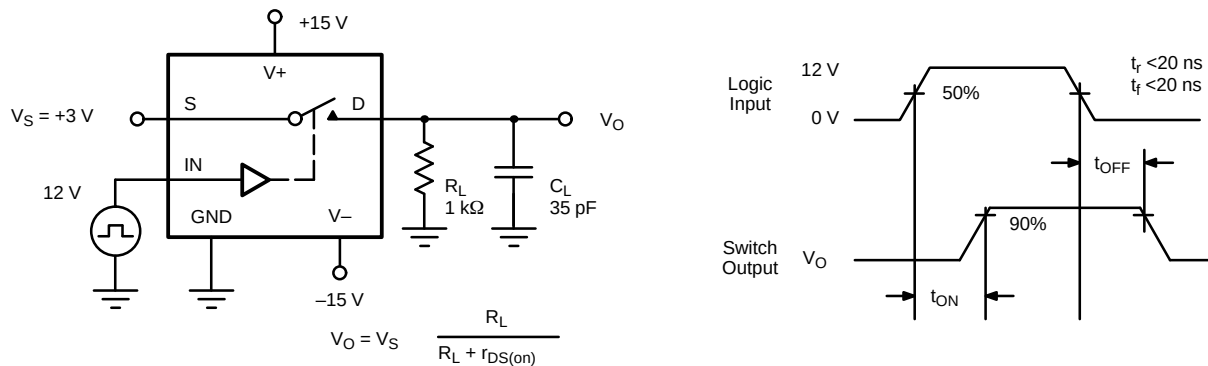
| Parameter                                   | Symbol              | Test Conditions<br>Unless Specified<br><br>V <sub>+</sub> = 12 V, V <sub>–</sub> = 0 V<br>V <sub>IN</sub> = 11 V, 3.5 V <sup>f</sup> | Temp <sup>b</sup> | Typ <sup>c</sup> | A Suffix<br>–55 to 125°C |                  | D Suffix<br>–40 to 85°C |                  | Unit |
|---------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------|--------------------------|------------------|-------------------------|------------------|------|
|                                             |                     |                                                                                                                                      |                   |                  | Min <sup>d</sup>         | Max <sup>d</sup> | Min <sup>d</sup>        | Max <sup>d</sup> |      |
| Analog Switch                               |                     |                                                                                                                                      |                   |                  |                          |                  |                         |                  |      |
| 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 <sub>D</sub> = 3 V, 8 V, I <sub>S</sub> = 1 mA                                                                                     | Room Full         | 90               |                          | 160<br>200       |                         | 160<br>200       | Ω    |
| Dynamic Characteristics                     |                     |                                                                                                                                      |                   |                  |                          |                  |                         |                  |      |
| Turn-On Time                                | t <sub>ON</sub>     | V <sub>S</sub> = 8 V, See Figure 2                                                                                                   | Room              |                  |                          | 300              |                         | 300              | ns   |
| Turn-Off Time                               | t <sub>OFF</sub>    |                                                                                                                                      | Room              |                  |                          | 200              |                         | 200              |      |
| Charge Injection                            | Q                   | C <sub>L</sub> = 1 nF, V <sub>gen</sub> = 6 V, R <sub>gen</sub> = 0 Ω                                                                | Room              | 4                |                          |                  |                         |                  | pC   |
| Power Supply                                |                     |                                                                                                                                      |                   |                  |                          |                  |                         |                  |      |
| Positive Supply Current                     | I <sub>+</sub>      | V <sub>IN</sub> = 0 or 12 V                                                                                                          | Room Full         |                  |                          | 1<br>5           |                         | 1<br>5           | μA   |
| Negative Supply Current                     | I <sub>–</sub>      |                                                                                                                                      | Room Full         |                  | –1<br>–5                 |                  | –1<br>–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<sub>IN</sub> = 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

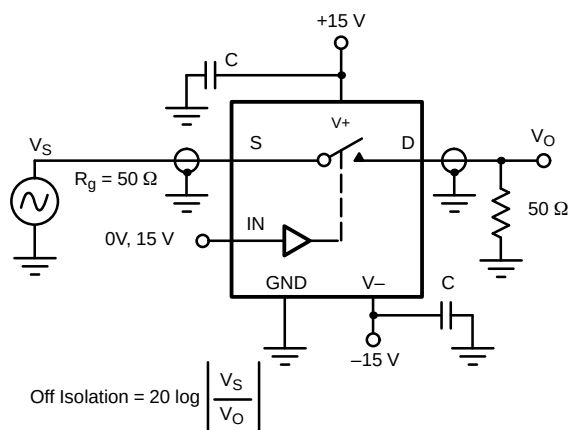


FIGURE 3. Off Isolation

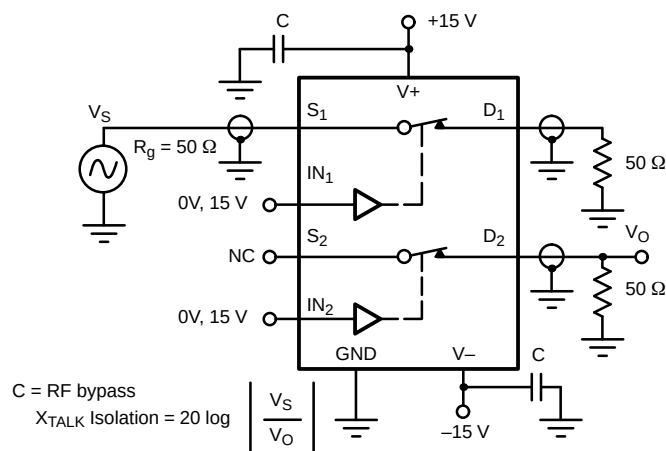


FIGURE 4. Channel-to-Channel Crosstalk

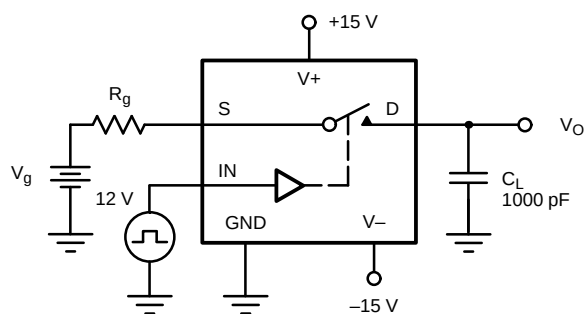
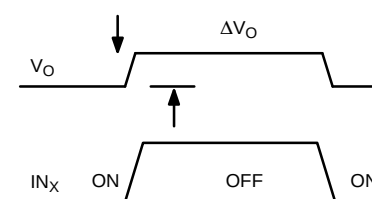


FIGURE 5. Charge Injection



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

### APPLICATIONS

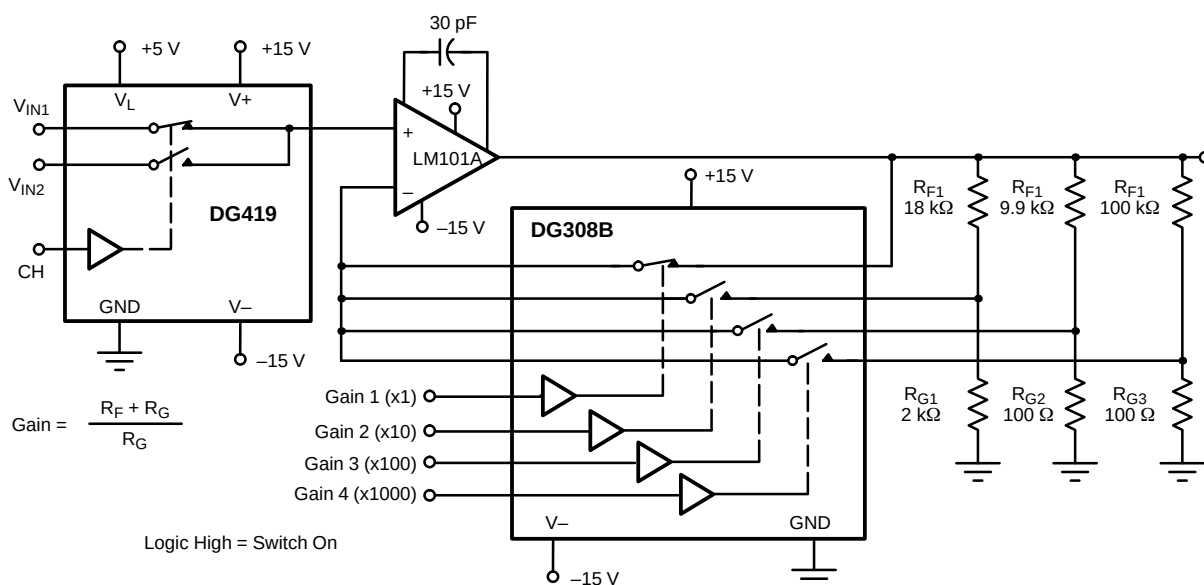
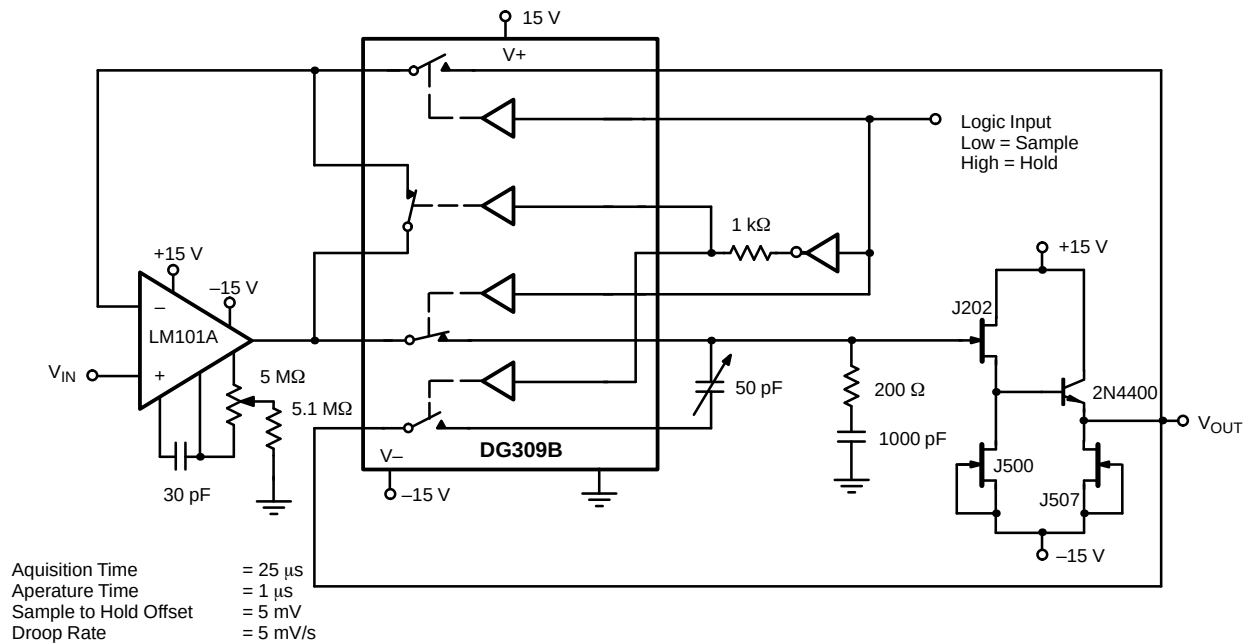
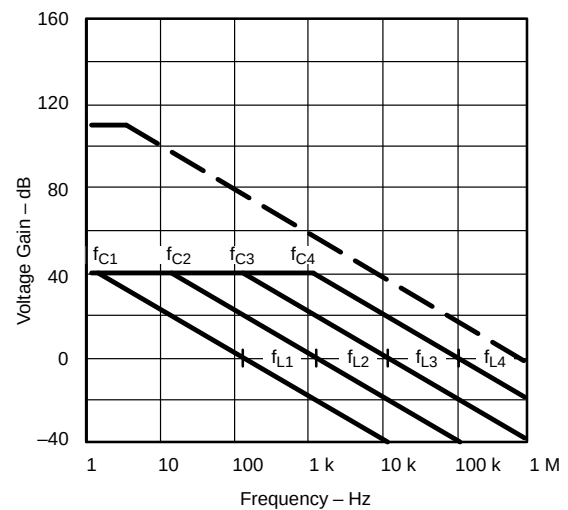
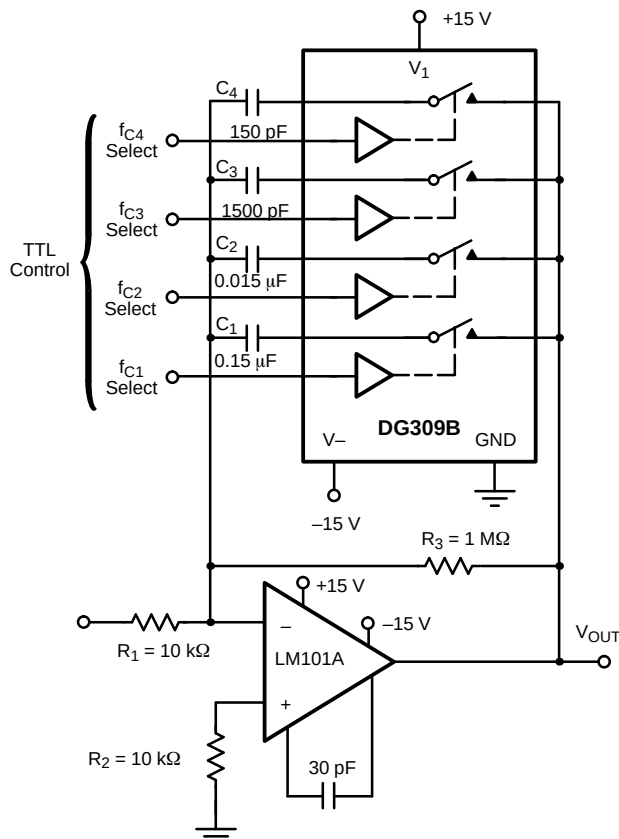


FIGURE 6. A Precision Amplifier with Digitally Programmable Inputs and Gains

**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**