

Improved Quad CMOS Analog Switches

FEATURES

- ± 22 -V Supply Voltage Rating
- TTL and CMOS Compatible Logic
- Low On-Resistance— $r_{DS(on)}$: 45Ω
- Low Leakage— $I_{D(on)}$: 20 pA
- Single Supply Operation Possible
- Extended Temperature Range
- Fast Switching— t_{ON} : 120 ns
- Low Glitching— Q : 1 pC

BENEFITS

- Wide Analog Signal Range
- Simple Logic Interface
- Higher Accuracy
- Minimum Transients
- Reduced Power Consumption
- Superior to DG201A/202
- Space Savings (TSSOP)

APPLICATIONS

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

DESCRIPTION

The DG201B/202B analog switches are highly improved versions of the industry-standard DG201A/202. 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.

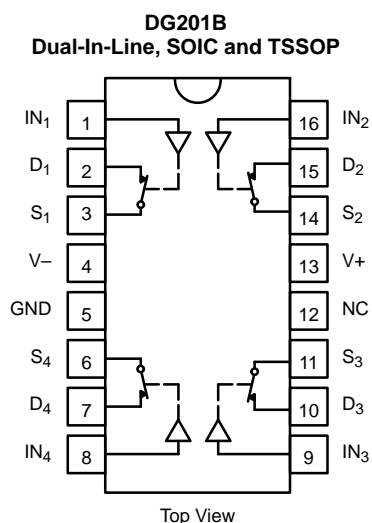
These quad single-pole single-throw switches are designed for a wide variety of applications in telecommunications, instrumentation, process control, computer peripherals, etc. An improved charge injection compensation design minimizes switching transients. The DG201B and DG202B can handle

up to ± 22 -V input signals, and have an improved continuous current rating of 30 mA . An epitaxial layer prevents latchup.

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

The DG201B is a normally closed switch and the DG202B is a normally open switch. (See Truth Table.)

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



| TRUTH TABLE | | |
|-------------|--------|--------|
| Logic | DG201B | DG202B |
| 0 | ON | OFF |
| 1 | OFF | ON |

Logic "0" $\leq 0.8 \text{ V}$
Logic "1" $\geq 2.4 \text{ V}$

| ORDERING INFORMATION | | |
|----------------------|--------------------|--------------|
| Temp Range | Package | Part Number |
| -40 to 85°C | 16-Pin Plastic DIP | DG201BDJ |
| | | DG202BDJ |
| | 16-Pin CerDIP | DG201BDK |
| | | DG202BDK |
| | 16-Pin Narrow SOIC | DG201BDY |
| | | DG202BDY |
| | 16-Pin TSSOP | DG201BDQ |
| | | DG202BDQ |
| -55 to 125°C | 16-Pin CerDIP | DG201BAK |
| | | DG201BAK/883 |
| | | DG202BAK |
| | | DG202BAK/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, DK 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 IN_X 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

SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

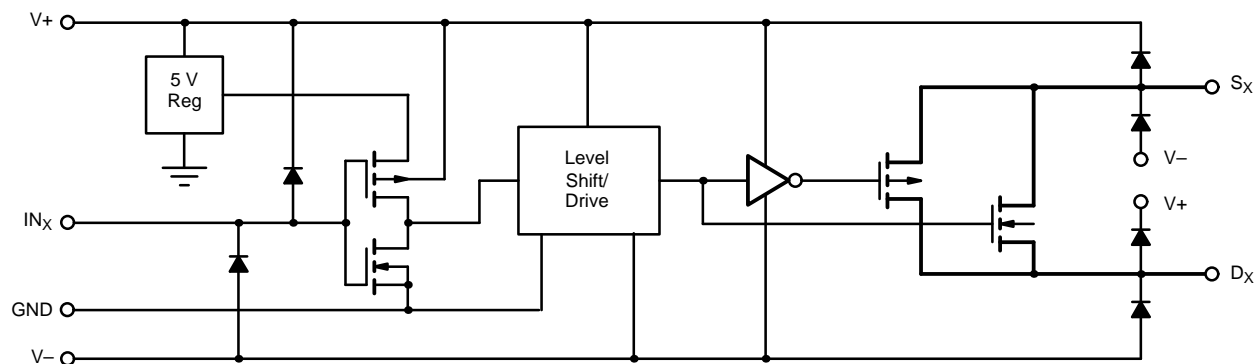


FIGURE 1.



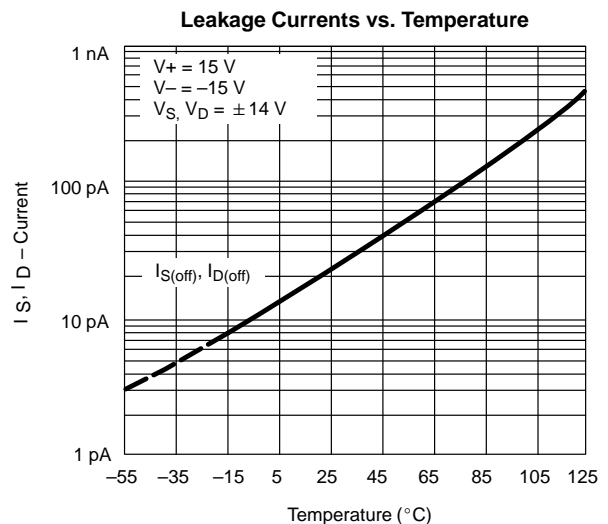
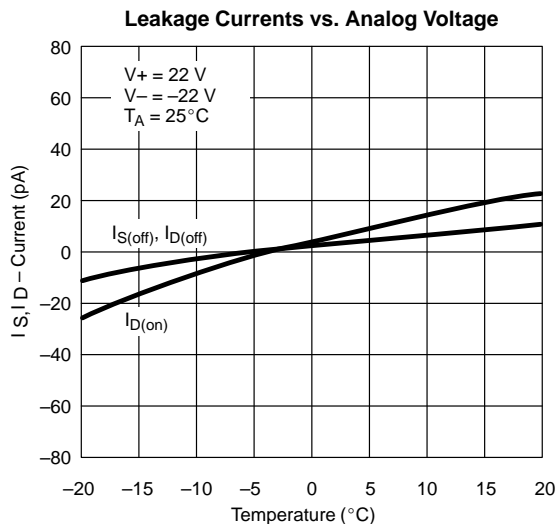
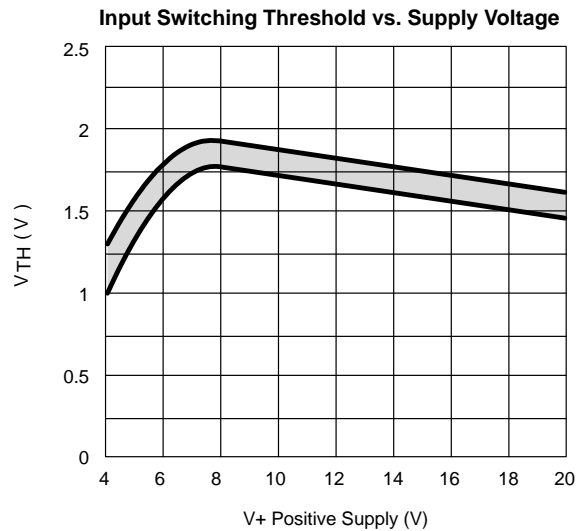
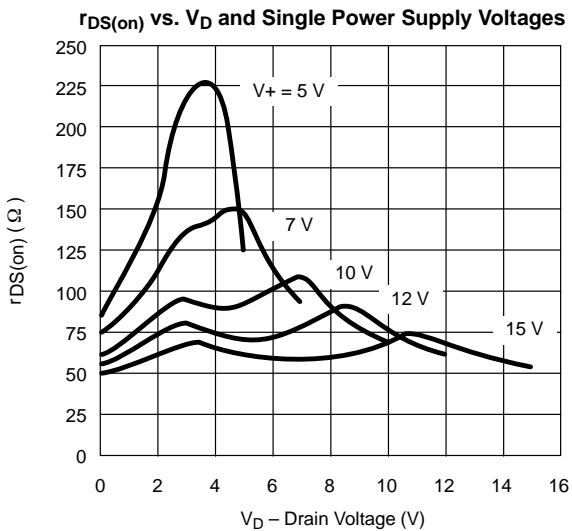
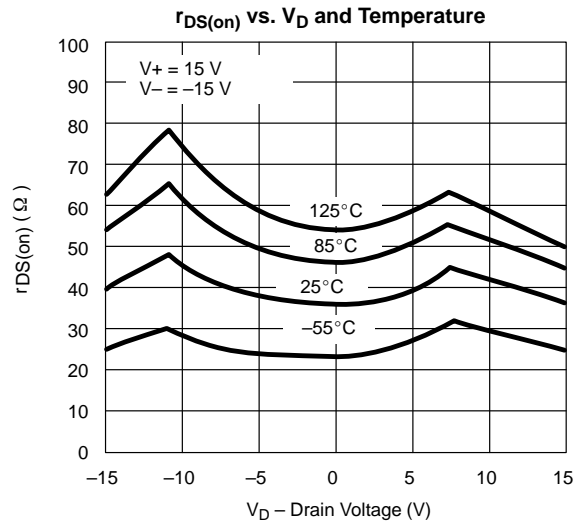
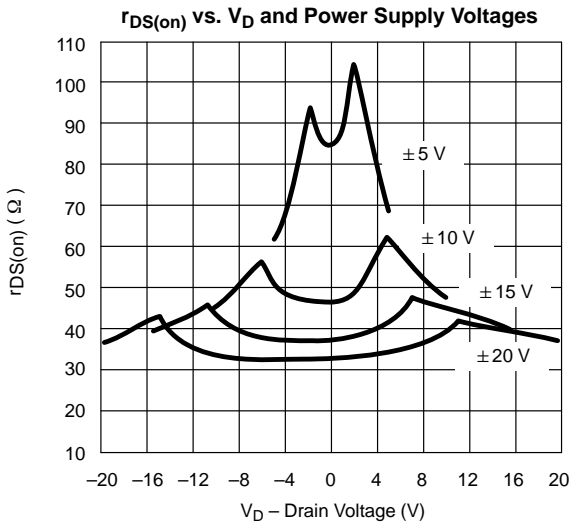
| SPECIFICATIONS ^a | | | | | | | | | |
|---|------------------------|---|-------------------|------------------|--------------------------|------------------|-------------------------|------------------|---------------|
| Parameter | Symbol | Test Conditions Unless Specified $V_+ = 15\text{ V}, V_- = -15\text{ V}$ $V_{IN} = 2.4\text{ V}, 0.8\text{ V}^f$ | 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 | | -15 | 15 | -15 | 15 | V |
| Drain-Source On-Resistance | $r_{DS(on)}$ | $V_D = \pm 10\text{ V}, I_S = 1\text{ mA}$ | Room Full | 45 | | 85 | | 85 | Ω |
| $r_{DS(on)}$ Match | $\Delta r_{DS(on)}$ | | Room | 2 | | | | | |
| Source Off Leakage Current | $I_{S(off)}$ | $V_S = \pm 14\text{ V}, V_D = \mp 14\text{ V}$ | Room Full | ± 0.01 | -0.5 -20 | 0.5 20 | -0.5 -5 | 0.5 5 | nA |
| Drain Off Leakage Current | $I_{D(off)}$ | $V_D = \pm 14\text{ V}, V_S = \mp 14\text{ V}$ | Room Full | ± 0.01 | -0.5 -20 | 0.5 20 | -0.5 -5 | 0.5 5 | |
| Drain On Leakage Current | $I_{D(on)}$ | $V_S = V_D = \pm 14\text{ V}$ | Room Full | ± 0.02 | -0.5 -40 | 0.5 40 | -0.5 -10 | 0.5 10 | |
| Digital Control | | | | | | | | | |
| Input Voltage High | V_{INH} | | Full | | 2.4 | | 2.4 | | V |
| Input Voltage Low | V_{INL} | | Full | | | 0.8 | | 0.8 | |
| 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} | $V_S = 2\text{ V}$ See Switching Time Test Circuit | Room Full | 120 | | 300 | | 300 | ns |
| Turn-Off Time | t_{OFF} | | Room Full | 65 | | 200 | | 200 | |
| Charge Injection | Q | $C_L = 1000\text{ pF}, V_g = 0\text{ V}$ $R_g = 0\ \Omega$ | Room | 1 | | | | | pC |
| Source-Off Capacitance | $C_{S(off)}$ | $V_S = 0\text{ V}, f = 1\text{ MHz}$ | Room | 5 | | | | | pF |
| Drain-Off Capacitance | $C_{D(off)}$ | | Room | 5 | | | | | |
| Channel On Capacitance | $C_{D(on)}$ | $V_D = V_S = 0\text{ V}, f = 1\text{ MHz}$ | Room | 16 | | | | | |
| Off Isolation | OIRR | $C_L = 15\text{ pF}, R_L = 50\ \Omega$ $V_S = 1\text{ V}_{RMS}, f = 100\text{ kHz}$ | Room | 90 | | | | | dB |
| Channel-to-Channel Crosstalk | X_{TALK} | | Room | 95 | | | | | |
| Power Supply | | | | | | | | | |
| Positive Supply Current | I_+ | $V_{IN} = 0\text{ or }5\text{ V}$ | Room Full | | | 50 100 | | 50 100 | μA |
| Negative Supply Current | I_- | | Room Full | | | -1 -5 | | -1 -5 | |
| Power Supply Range for Continuous Operation | V_{OP} | | Full | | ± 4.5 | ± 22 | ± 4.5 | ± 22 | V |



| SPECIFICATIONS FOR SINGLE SUPPLY ^a | | | | | | | | | |
|---|--------------|---|-------------------|------------------|--------------------------|------------------|-------------------------|------------------|---------------|
| Parameter | Symbol | Test Conditions Unless Specified $V_+ = 12\text{ V}, V_- = 0\text{ V}$ $V_{IN} = 2.4\text{ V}, 0.8\text{ V}^f$ | 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} | $V_S = 8\text{ V}$ See Switching Time Test Circuit | Room | 120 | | 300 | | 300 | ns |
| Turn-Off Time | t_{OFF} | | Room | 60 | | 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_+ | $V_{IN} = 0\text{ or }5\text{ V}$ | Room Full | | | 50 100 | | 50 100 | μA |
| Negative Supply Current | I_- | | Room Full | | -1 -5 | | -1 -5 | | |
| Power Supply Range for Continuous Operation | V_{OP} | | Full | | +4.5 | +25 | +4.5 | +25 | V |

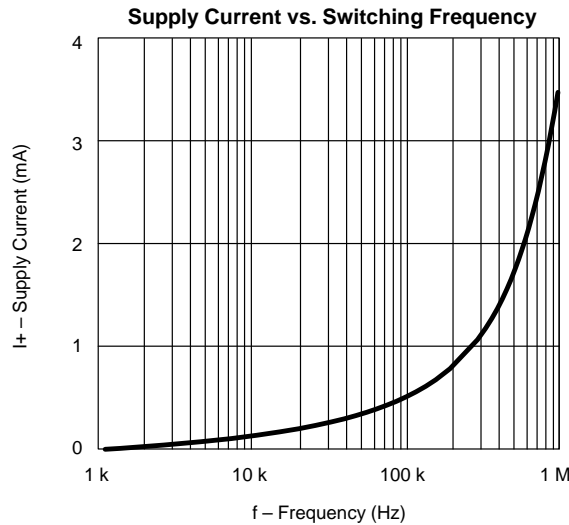
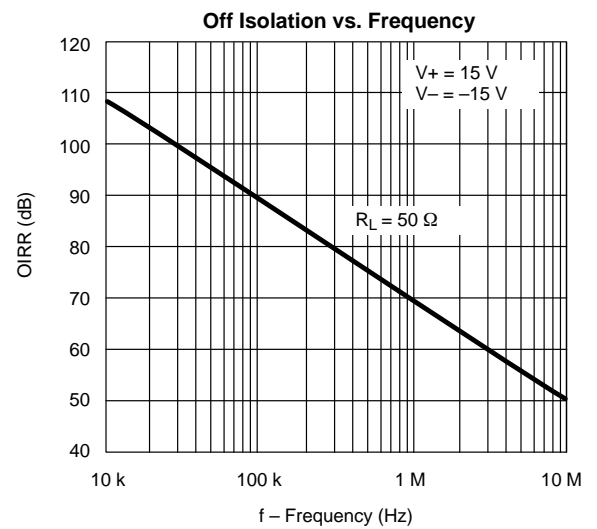
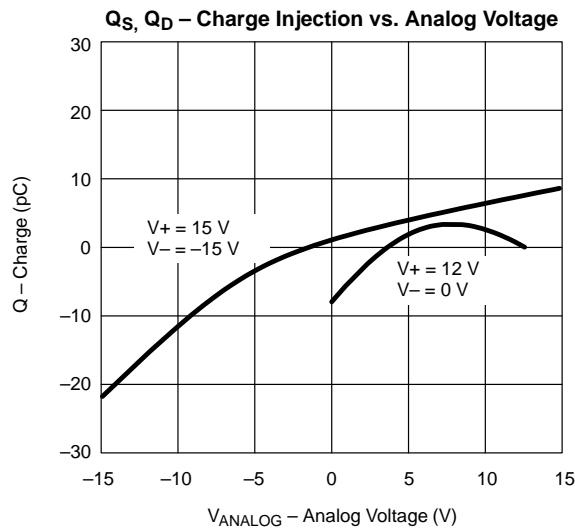
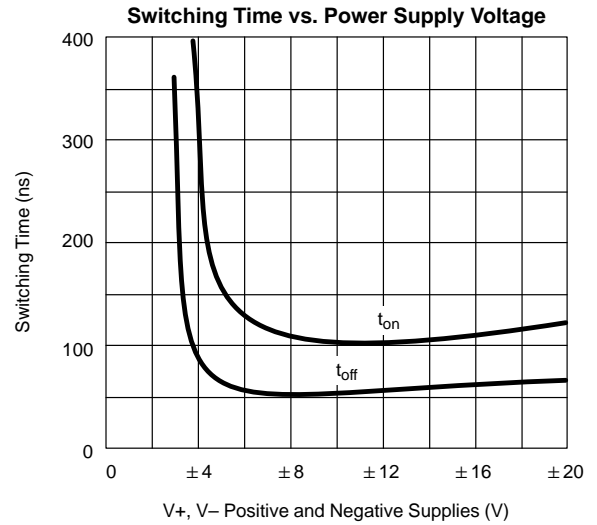
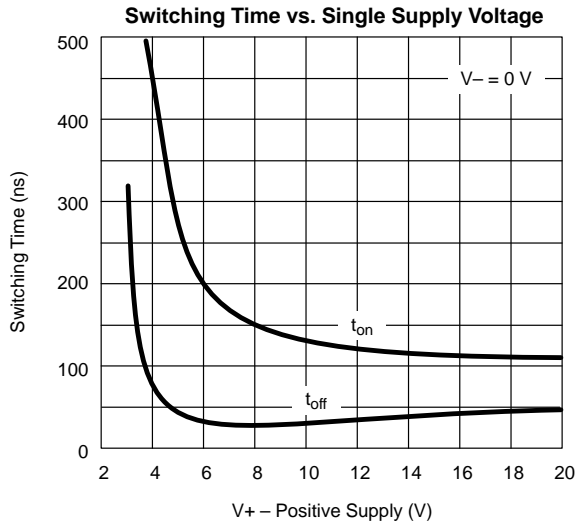
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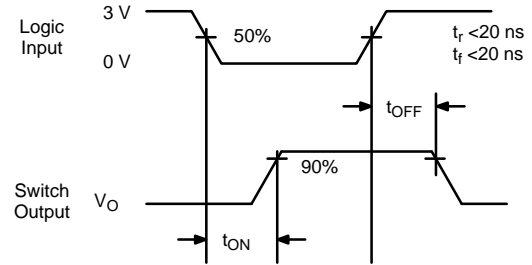
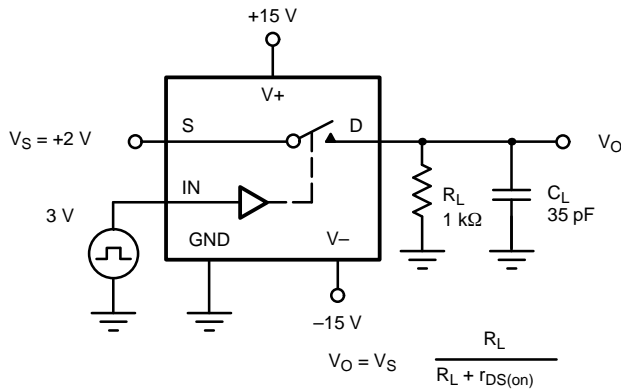
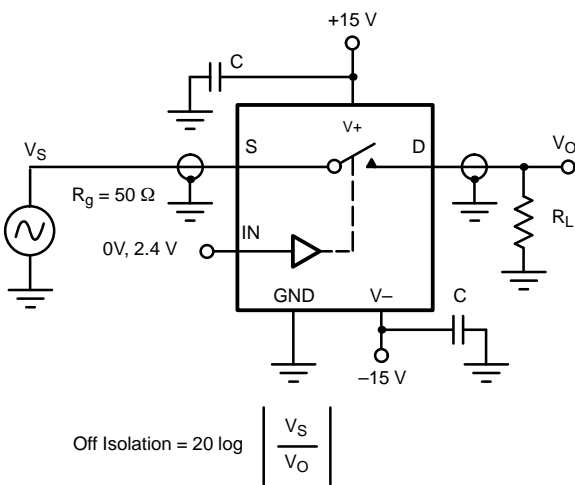
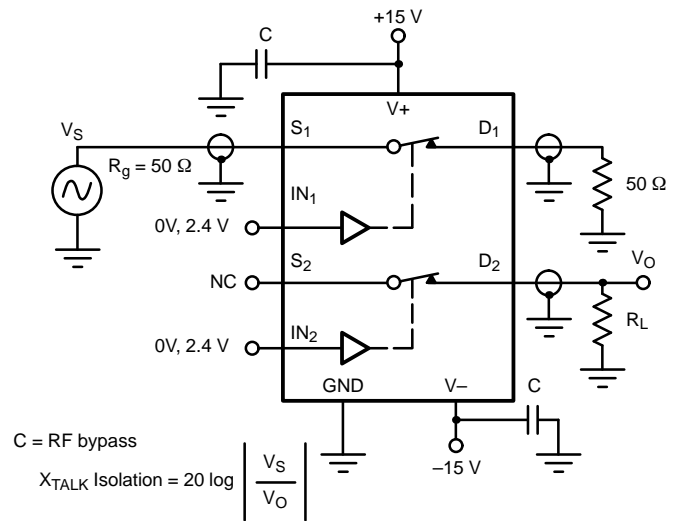
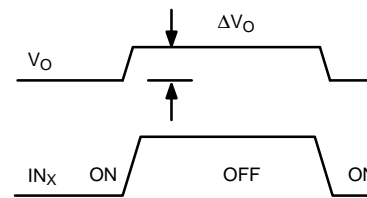
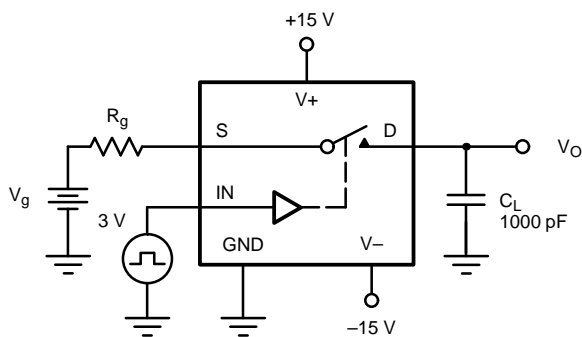
- Refer to PROCESS OPTION FLOWCHART.
- Room = 25°C, Full = as determined by the operating temperature suffix.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, 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)



TEST CIRCUITS

FIGURE 2. Switching Time

FIGURE 3. Off Isolation

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

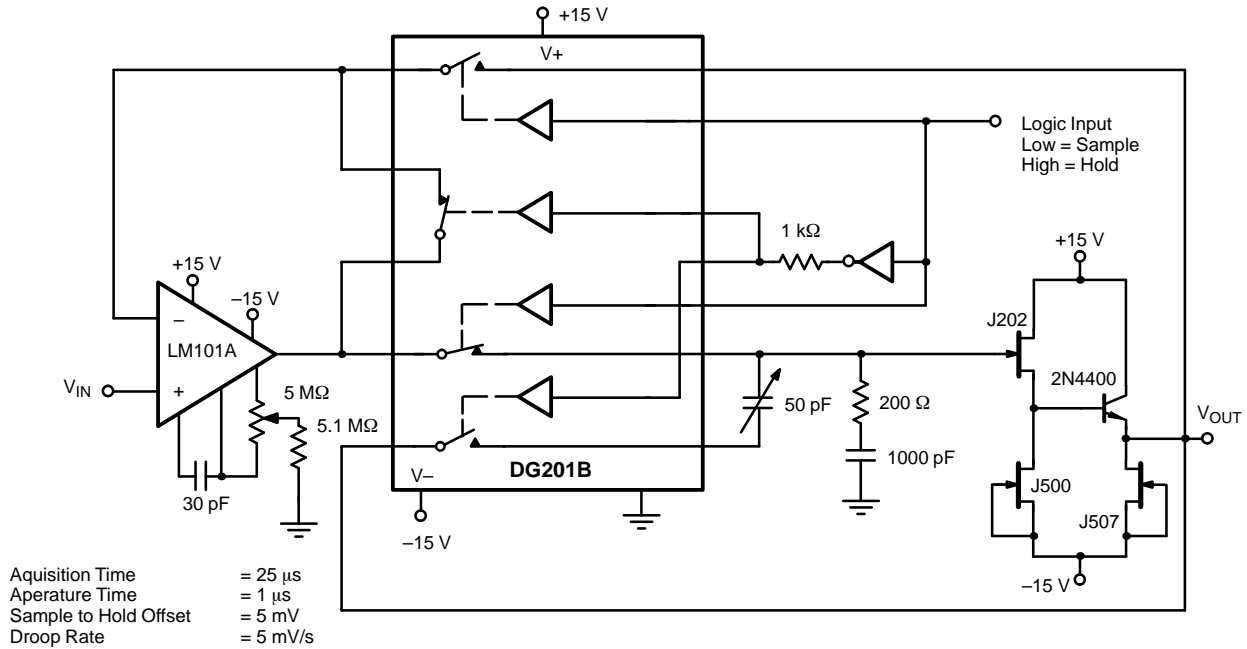
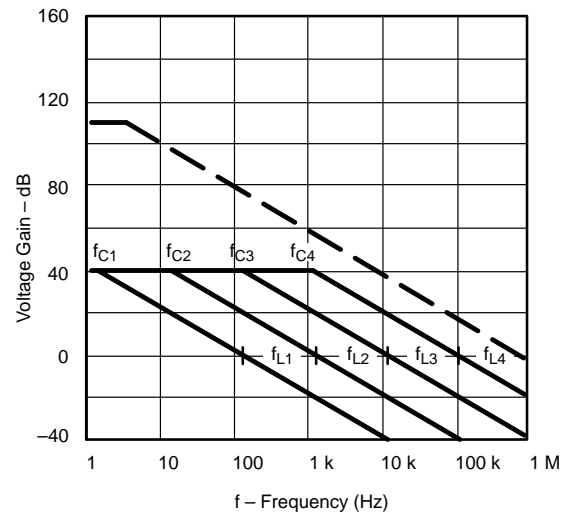
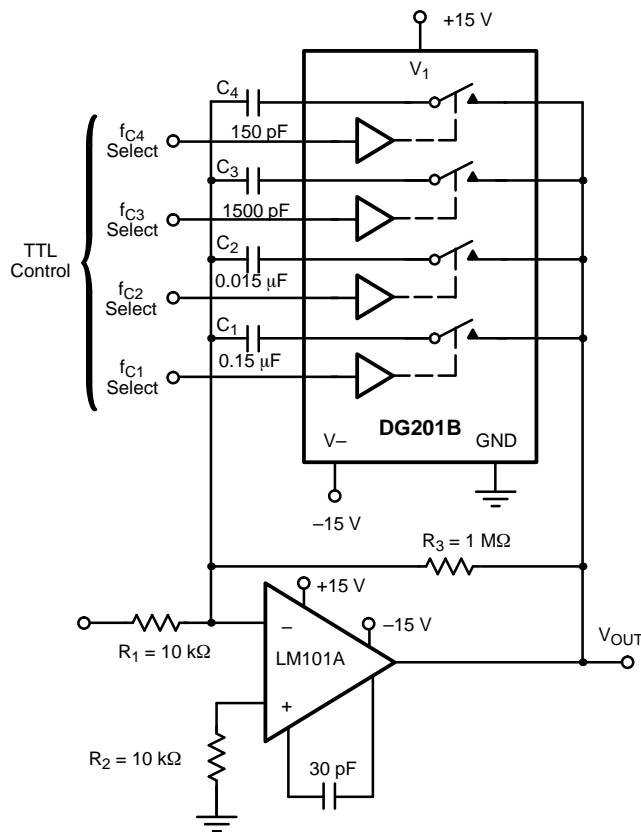


FIGURE 6. Sample-and-Hold



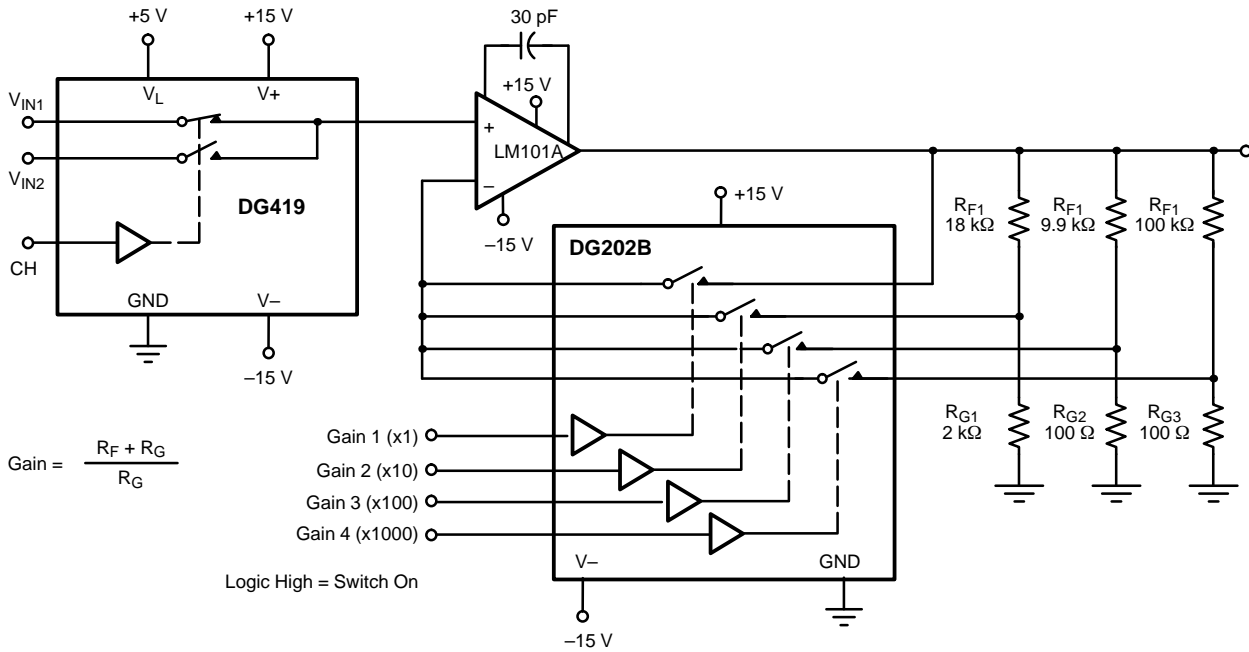
$$A_L \text{ (Voltage Gain Below Break Frequency)} = \frac{R_3}{R_1} = 100 \text{ (40 dB)}$$

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

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

$$\text{Max Attenuation} = \frac{r_{DS(on)}}{10 \text{ k}\Omega} \approx -47 \text{ dB}$$

FIGURE 7. Active Low Pass Filter with Digitally Selected Break Frequency

APPLICATIONS

FIGURE 8. A Precision Amplifier with Digitally Programmable Input and Gains