

## Improved Quad CMOS Analog Switches

### FEATURES

- $\pm 22\text{-V}$  Supply Voltage Rating
- TTL and 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— $t_{ON}$ :  $120\ \text{ns}$
- Low Glitching— $Q$ :  $1\ \text{pC}$

### BENEFITS

- Wide Analog Signal Range
- Simple Logic Interface
- Higher Accuracy
- Minimum Transients
- Reduced Power Consumption
- Superior to 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.

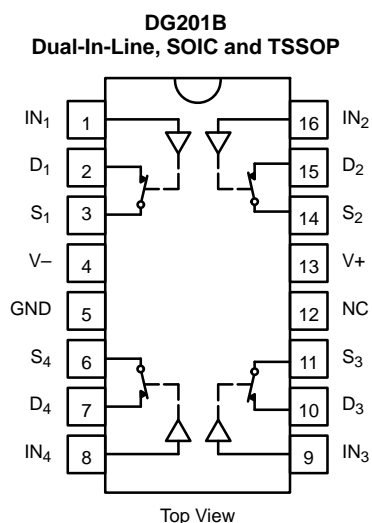
These quad single-pole single-throw switches are designed for a wide variety of applications in telecommunications, instrumentation, process control, computer peripherals, etc. An improved charge injection compensation design minimizes switching transients. The DG201B and DG202B can handle

up to  $\pm 22\text{-V}$  input signals, and have an improved continuous current rating of  $30\ \text{mA}$ . 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<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, DK 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 IN<sub>X</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

### SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

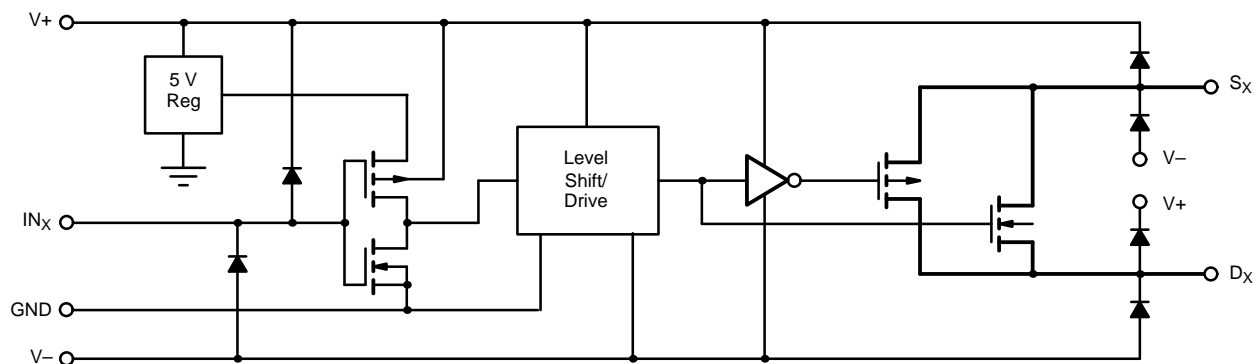


FIGURE 1.



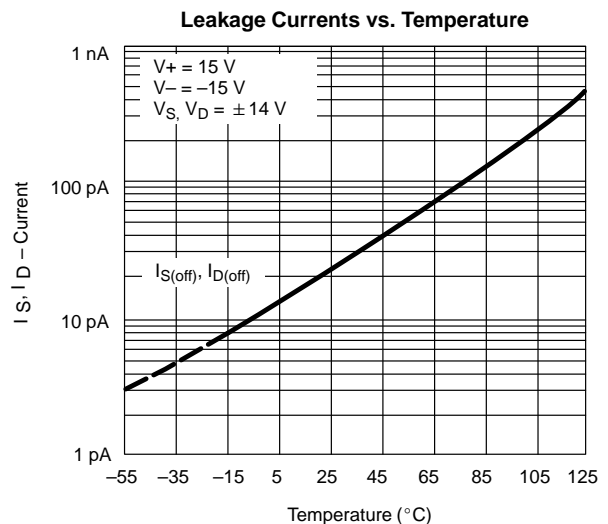
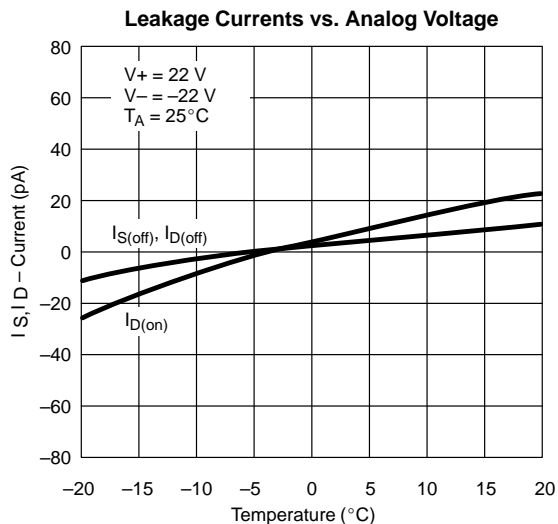
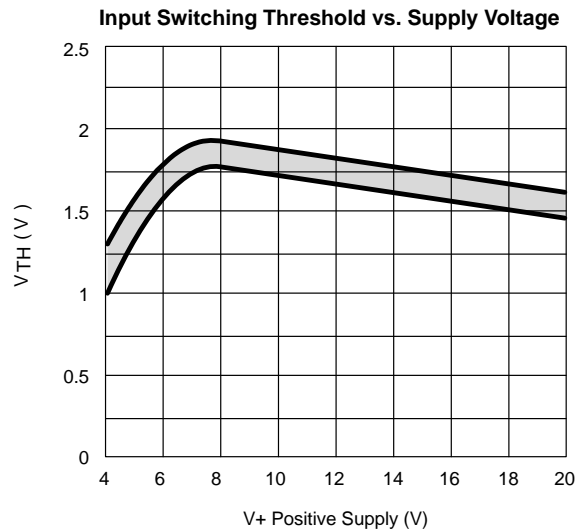
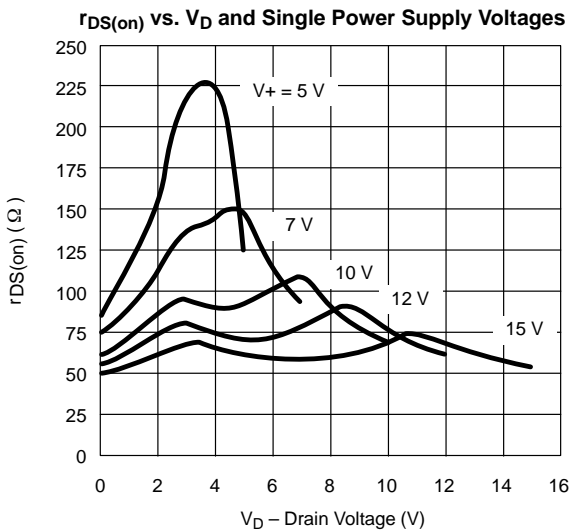
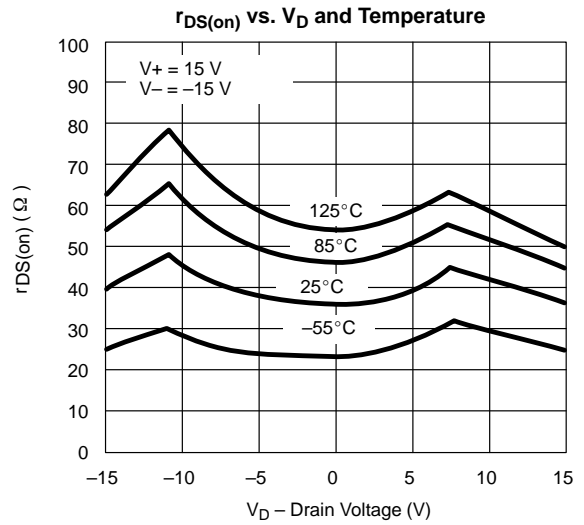
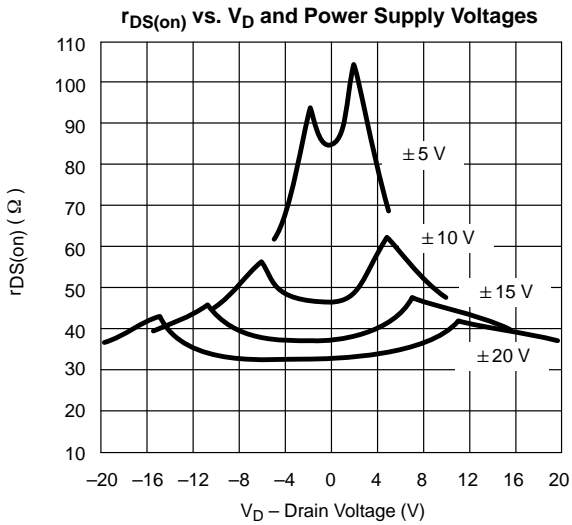
SPECIFICATIONS <sup>a</sup>									
Parameter	Symbol	Test Conditions Unless Specified $V_+ = 15\text{ V}$ , $V_- = -15\text{ V}$ $V_{IN} = 2.4\text{ V}$ , $0.8\text{ V}^f$	Temp <sup>b</sup>	Typ <sup>c</sup>	A Suffix -55 to 125°C		D Suffix -40 to 85°C		Unit
					Min <sup>d</sup>	Max <sup>d</sup>	Min <sup>d</sup>	Max <sup>d</sup>	
<b>Analog Switch</b>									
Analog Signal Range <sup>e</sup>	$V_{ANALOG}$		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	$\Omega$
$r_{DS(on)}$ 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	$\pm 0.01$	-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	$\pm 0.01$	-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	$\pm 0.02$	-0.5 -40	0.5 40	-0.5 -10	0.5 10	
<b>Digital Control</b>									
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	$\mu\text{A}$
Input Capacitance	$C_{IN}$		Room	5					pF
<b>Dynamic Characteristics</b>									
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					
<b>Power Supply</b>									
Positive Supply Current	$I_+$	$V_{IN} = 0$ or $5\text{ V}$	Room Full			50 100		50 100	$\mu\text{A}$
Negative Supply Current	$I_-$		Room Full			-1 -5		-1 -5	
Power Supply Range for Continuous Operation	$V_{OP}$		Full		$\pm 4.5$	$\pm 22$	$\pm 4.5$	$\pm 22$	V



SPECIFICATIONS FOR SINGLE SUPPLY <sup>a</sup>									
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 <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>	$V_{ANALOG}$		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	$\Omega$
<b>Dynamic Characteristics</b>									
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
<b>Power Supply</b>									
Positive Supply Current	$I_+$	$V_{IN} = 0\text{ or }5\text{ V}$	Room Full			50 100		50 100	$\mu\text{A}$
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

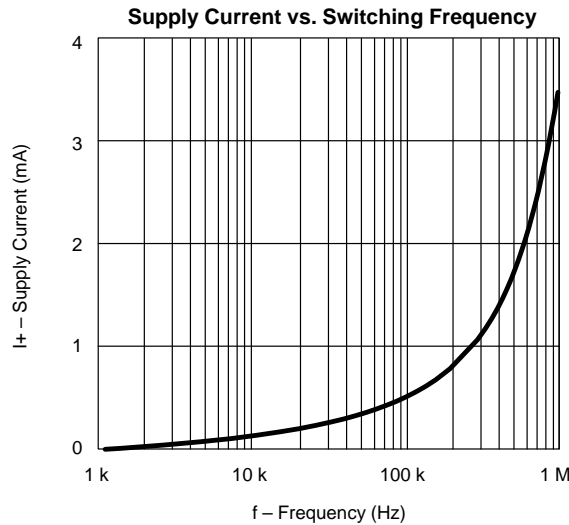
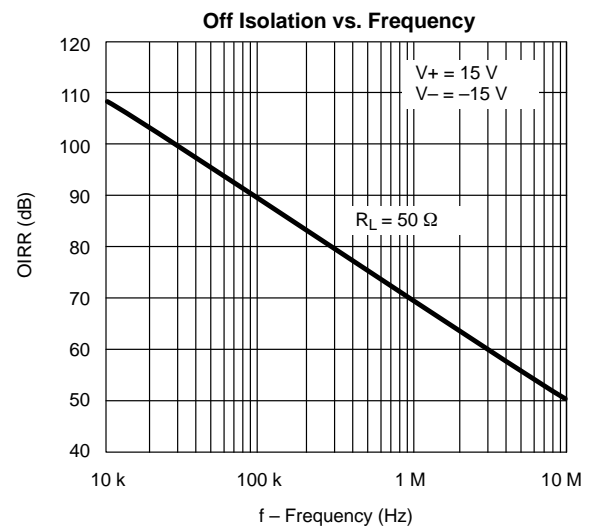
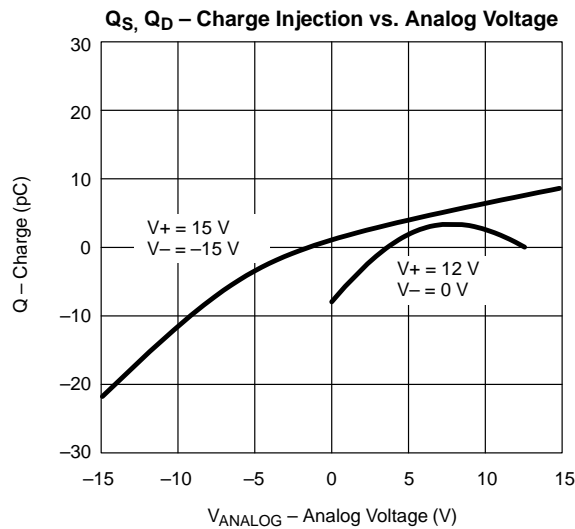
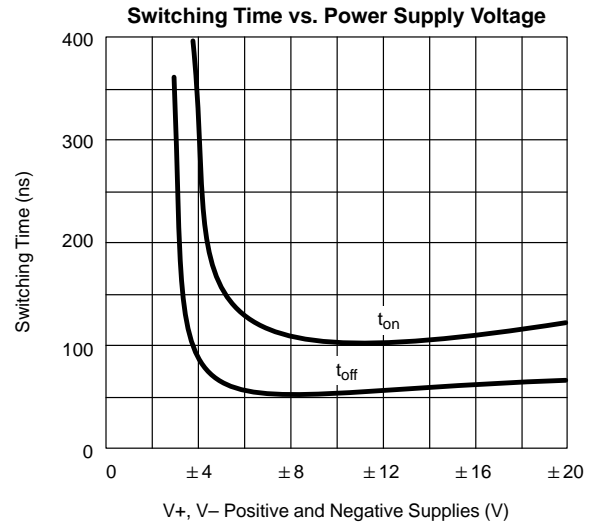
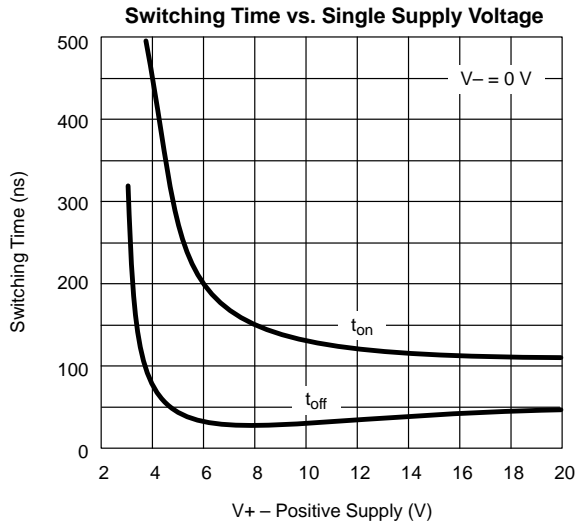
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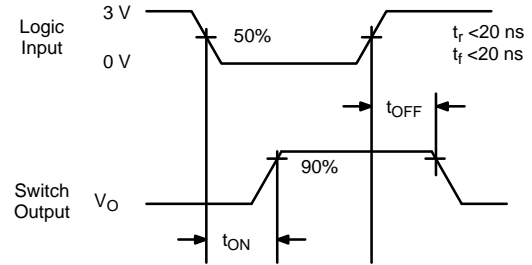
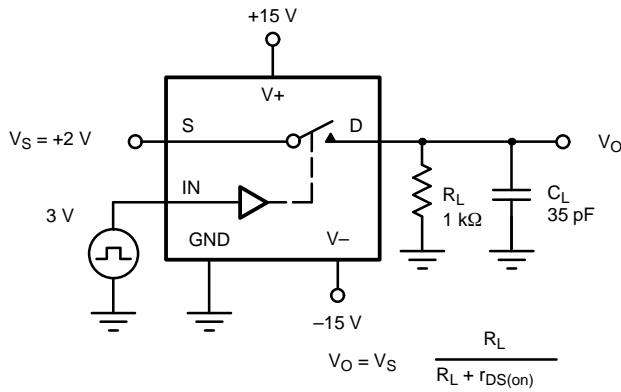
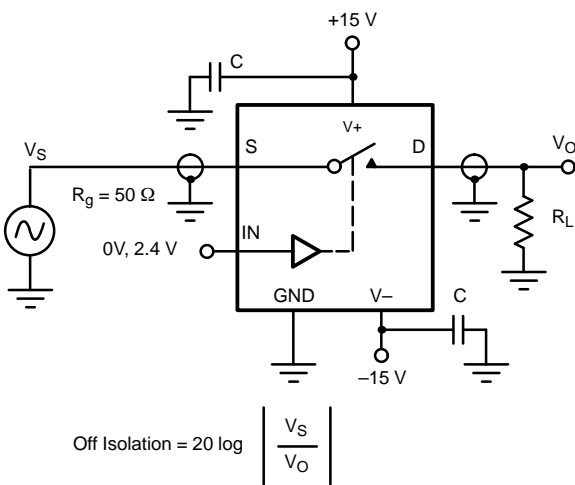
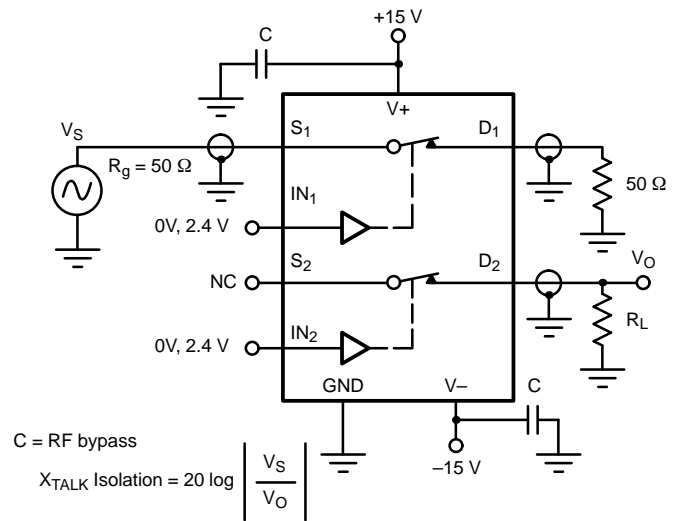
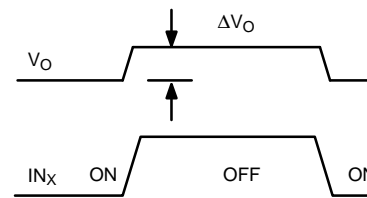
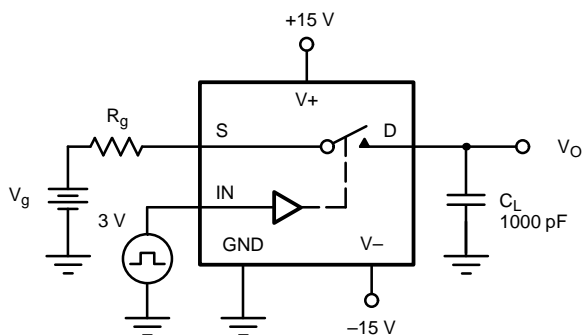
- Refer to PROCESS OPTION FLOWCHART.
- Room = 25°C, Full = as determined by the operating temperature suffix.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum,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


$\Delta V_O$  = 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**

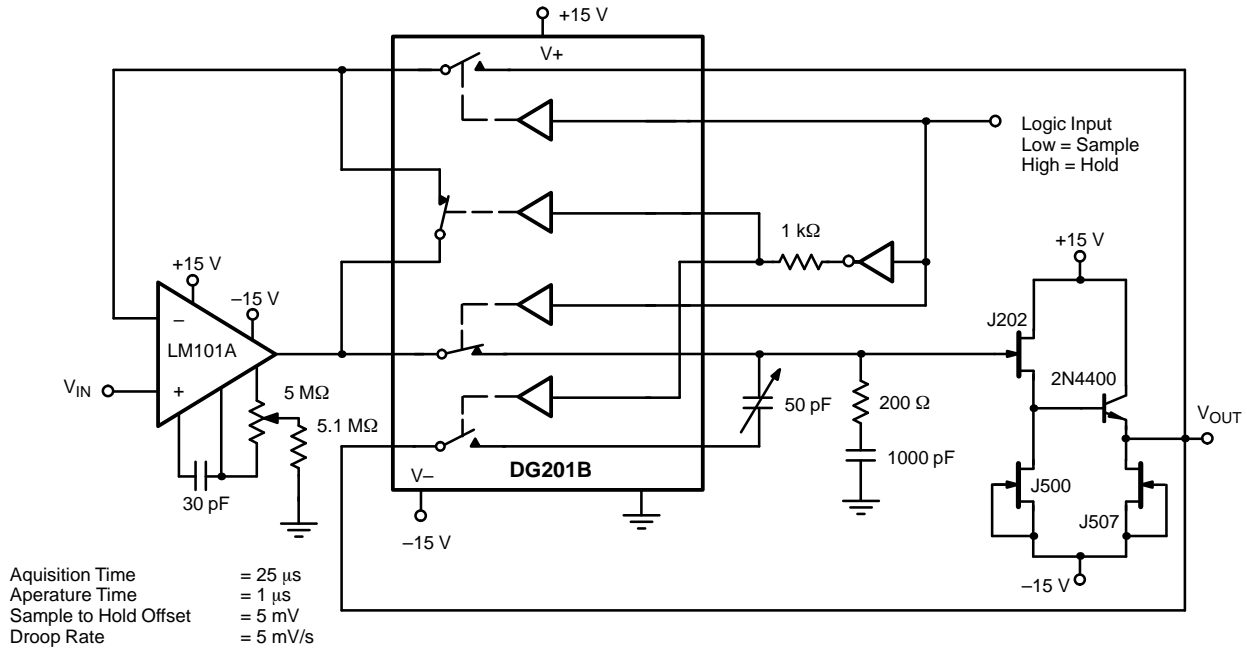
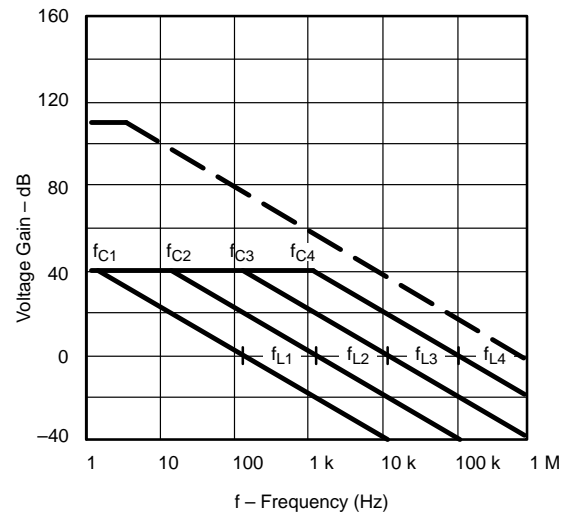
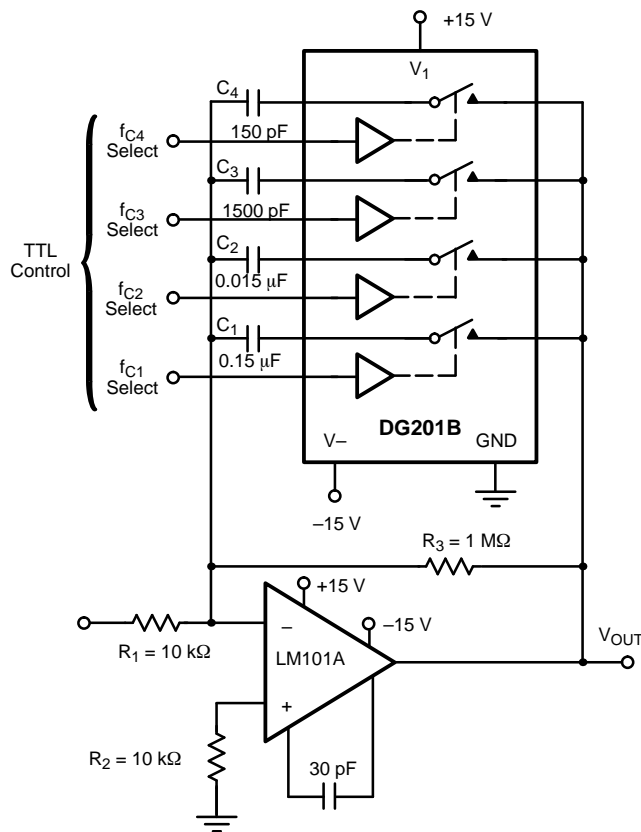


FIGURE 6. Sample-and-Hold



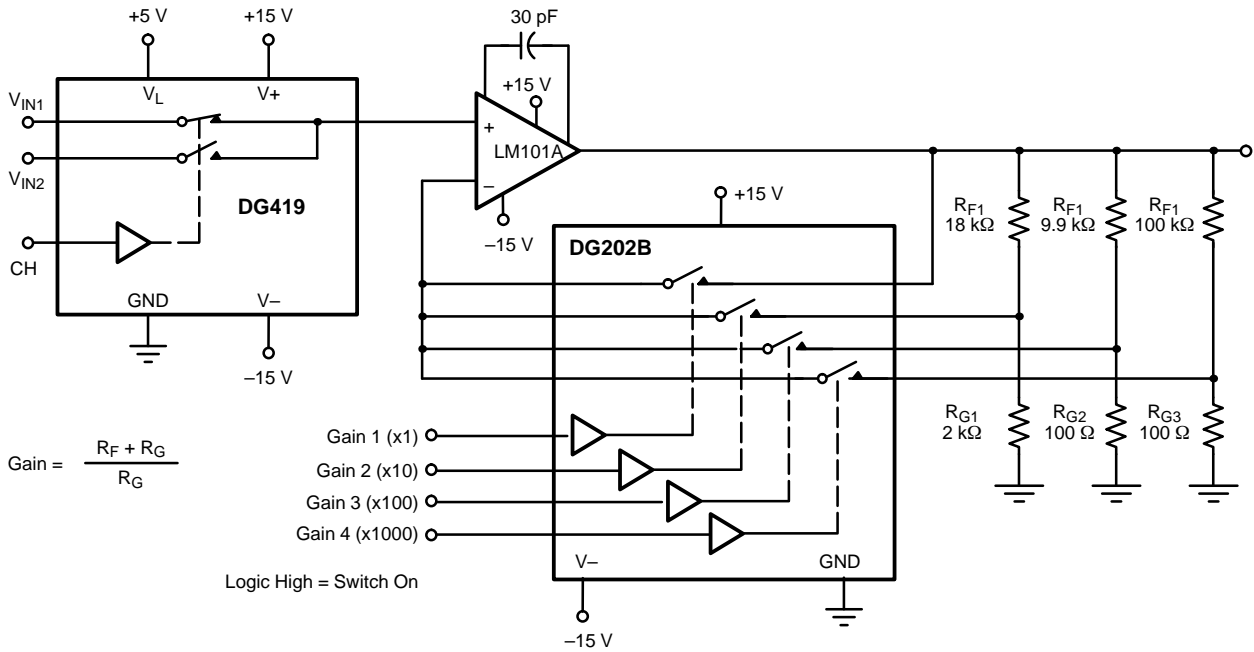
$$A_L \text{ (Voltage Gain Below Break Frequency)} = \frac{R_3}{R_1} = 100 \text{ (40 dB)}$$

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

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

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

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

**APPLICATIONS**

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



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