

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

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 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

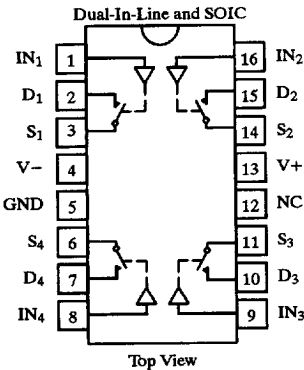
minimizes switching transients. The DG201B and DG202B can handle up to $\pm 22\text{-V}$ input signals, and have an improved continuous current rating of $30\ \text{mA}$. An epitaxial layer prevents latchup.

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

DG201B



Truth Table

Logic	DG201B	DG202B
0	ON	OFF
1	OFF	ON

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

Switches Shown for Logic "1" Input

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
-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 Suffix) –65 to 125°C

Power Dissipation (Package)^b

16-Pin Plastic DIP^c 470 mW

16-Pin Narrow SOIC^d 640 mW

16-Pin CerDIP^e 900 mW

Notes:

a. 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.

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^a

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 15 V, V− = −15 V VIN = 2.4 V, 0.8 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 Full	45		85 100		85 100	Ω
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 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 = ±14 V, V _S = ∓14 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 = 14 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 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 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 Otherwise Specified V+ = 15 V, V- = -15 V VIN = 2.4 V, 0.8 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+	VIN = 0 or 5 V	Room Full			50 100		50 100	μA
Negative Supply Current	I-		Room Full		-1 -5		-1 -5		
Power Supply Range for Continuous Operation	VOP		Full		± 4.5	± 22	± 4.5	± 22	V

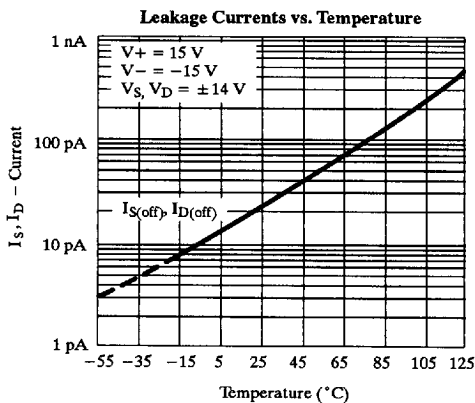
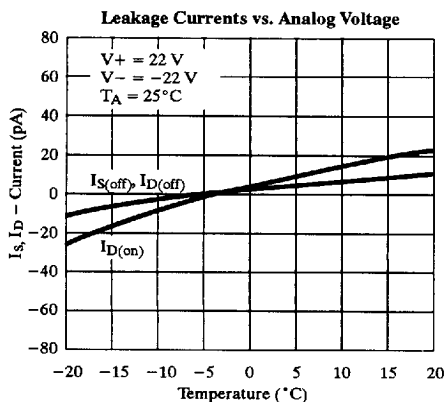
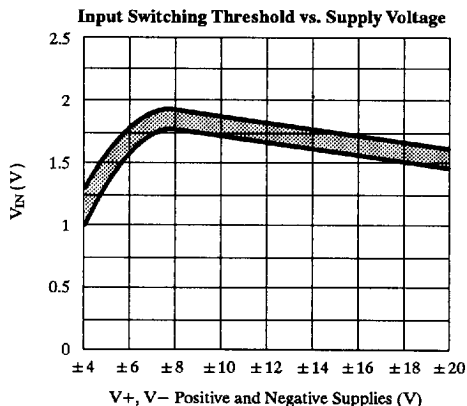
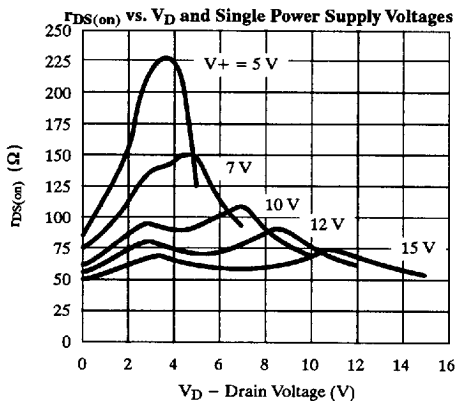
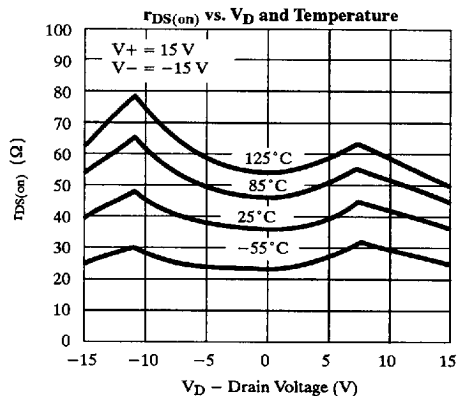
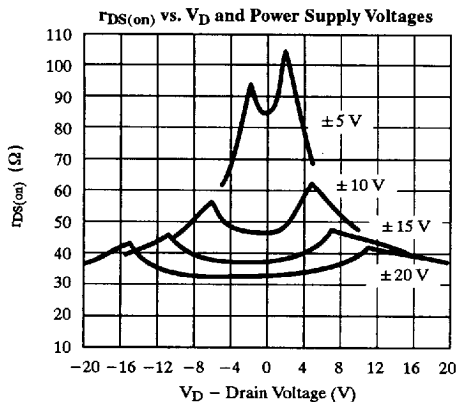
Specifications^a for Single Supply

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 12 V, V- = 0 V VIN = 2.4 V, 0.8 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	VANALOG		Full		0	12	0	12	V
Drain-Source On-Resistance	rDS(on)	VD = 3 V, 8 V, IS = 1 mA	Room Full	90		160 200		160 200	Ω
Dynamic Characteristics									
Turn-On Time	tON	VS = 8 V See Switching Time Test Circuit	Room	120		300		300	ns
Turn-Off Time	tOFF		Room	60		200		200	
Charge Injection	Q	CL = 1 nF, Vgen = 6 V, Rgen = 0 Ω	Room	4					pC
Power Supply									
Positive Supply Current	I+	VIN = 0 or 5 V	Room Full			50 100		50 100	μA
Negative Supply Current	I-		Room Full		-1 -5		-1 -5		
Power Supply Range for Continuous Operation	VOP		Full		+4.5	+25	+4.5	+25	V

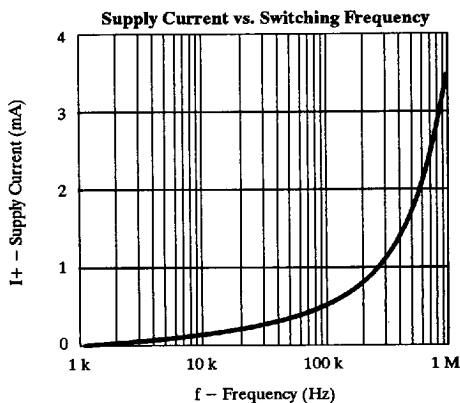
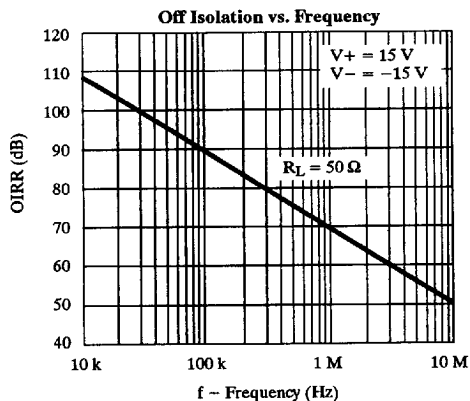
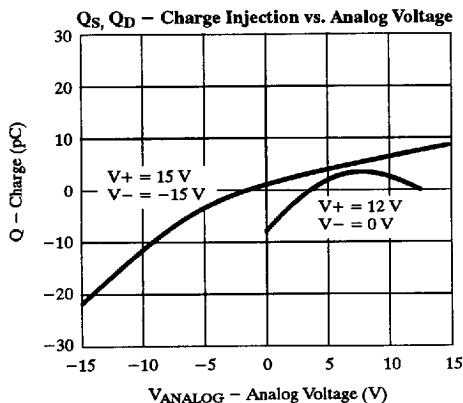
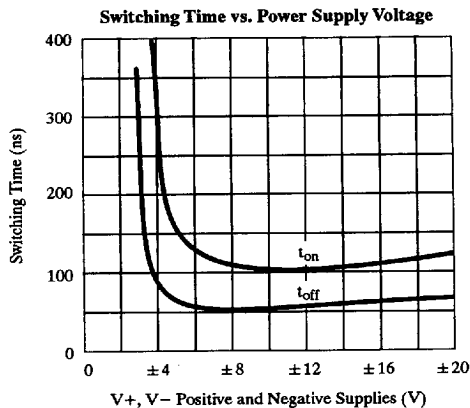
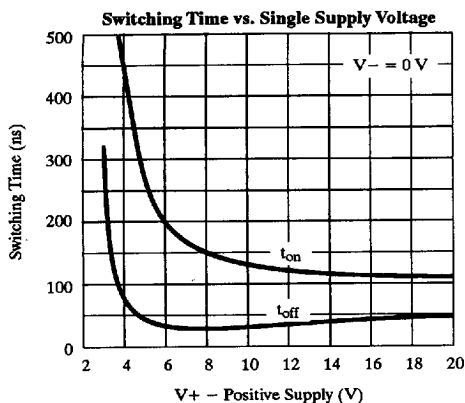
Notes:

- Refer to PROCESS OPTION FLOWCHART (Section 5 of the 1994 Data Book or FaxBack number 7103).
- 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



Typical Characteristics (Cont'd)



Schematic Diagram (Typical Channel)

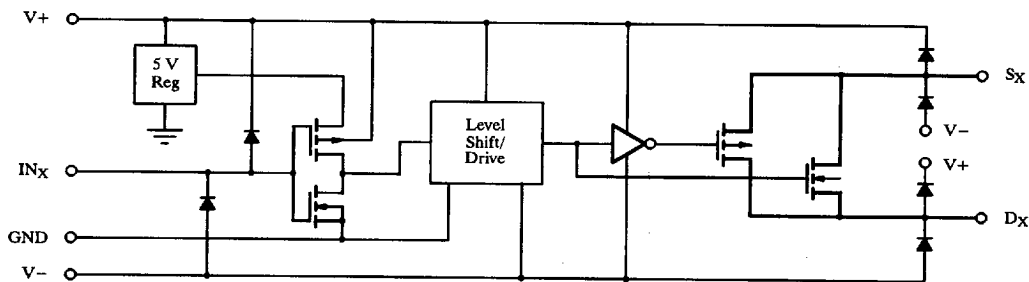


Figure 1.

Test Circuits

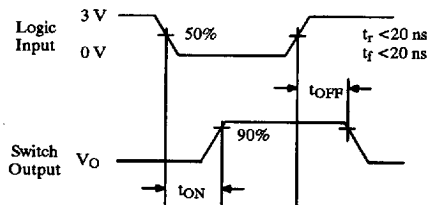
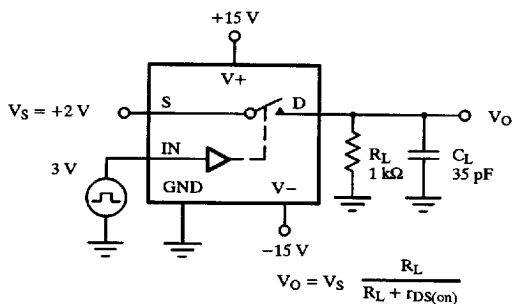


Figure 2. Switching Time

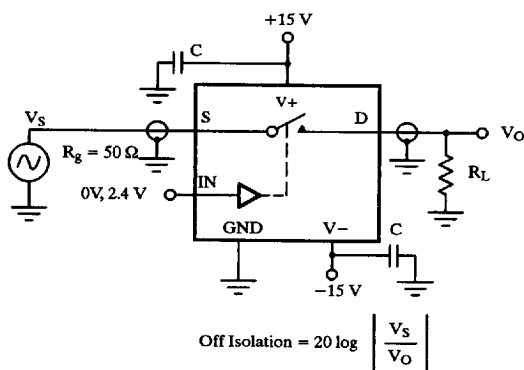


Figure 3. Off Isolation

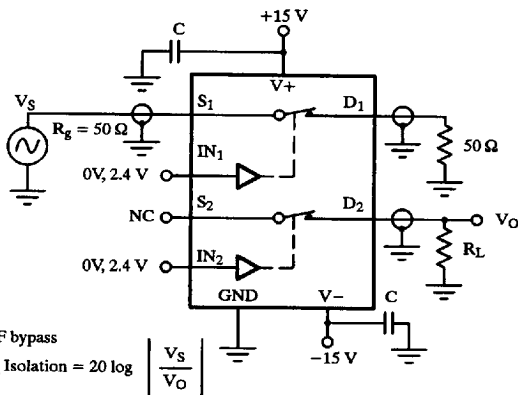
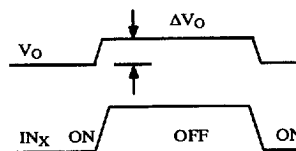
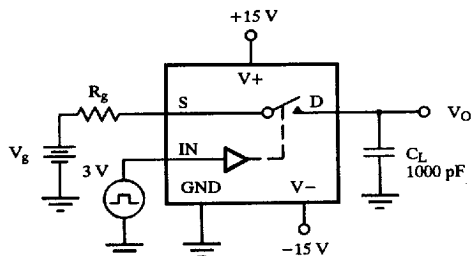


Figure 4. Channel-to-Channel Crosstalk

Test Circuits (Cont'd)



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

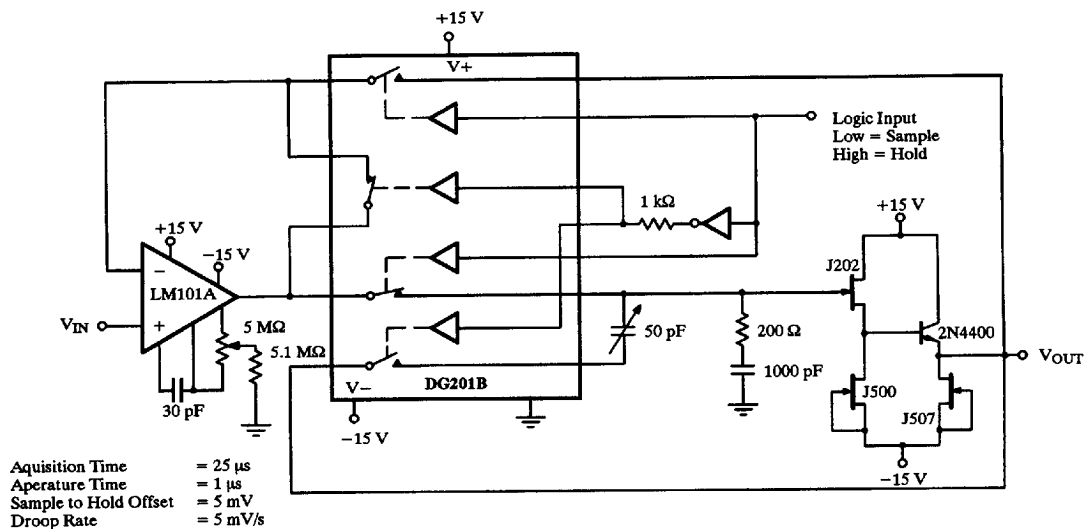
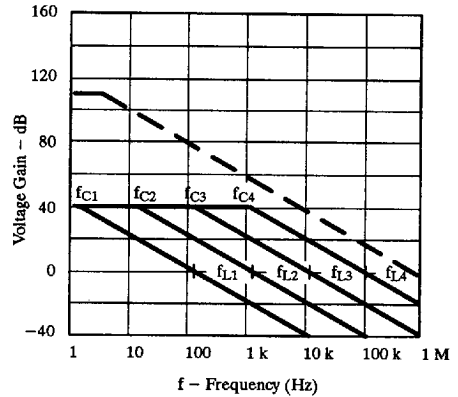
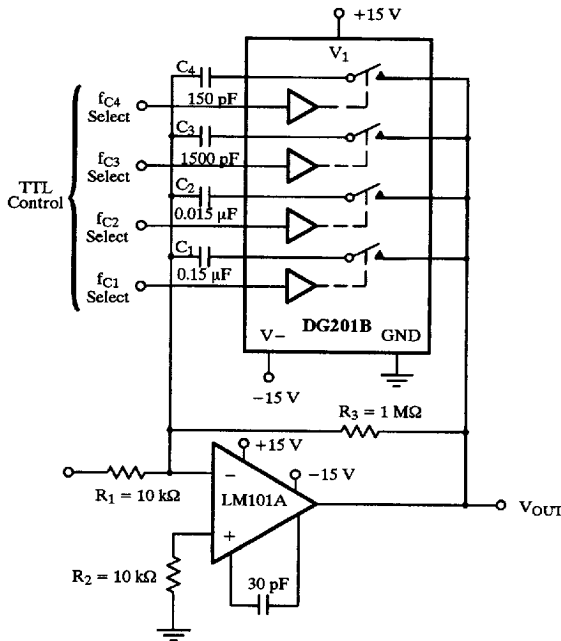


Figure 6. Sample-and-Hold

Applications (Cont'd)



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

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

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

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

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

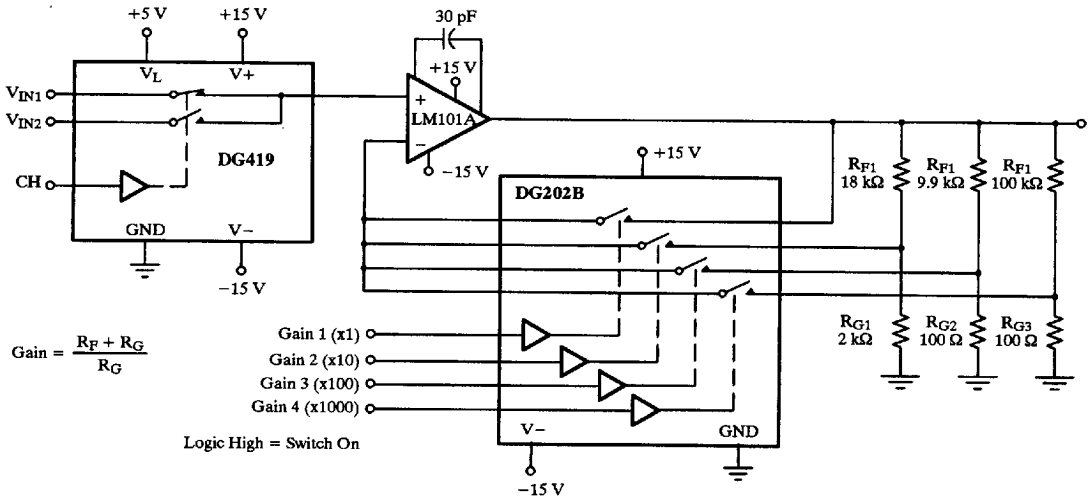


Figure 8. A Precision Amplifier with Digitally Programmable Input and Gains