Improved Quad CMOS Analog Switches

DESCRIPTION

The DG201B, DG202B analog switches are highly improved versions of the industry-standard DG201A, DG202. 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.)

FEATURES

- ± 22 V supply voltage rating
- TTL and CMOS compatible logic
- Low on-resistance - $R_{DS(on)}$: 45 Ω
- 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
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free Available

RoHS* Available

HALOGEN FREE

Note

* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

BENEFITS

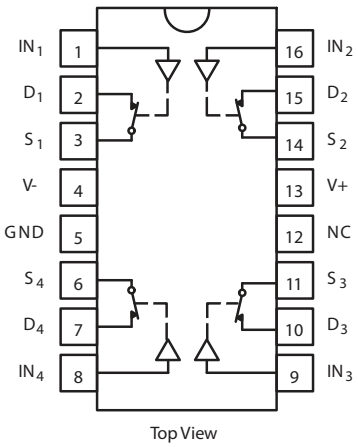
- Wide analog signal range
- Simple logic interface
- Higher accuracy
- Minimum transients
- Reduced power consumption
- Superior to DG201A, DG202
- Space savings (TSSOP)

APPLICATIONS

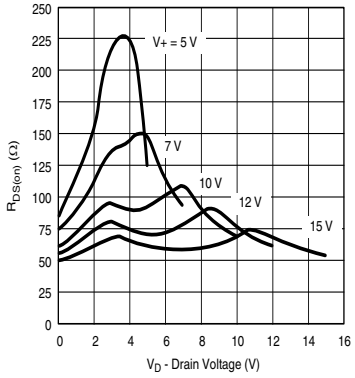
- Industrial instrumentation
- Test equipment
- Communications systems
- Disk drives
- Computer peripherals
- Portable instruments
- Sample-and-hold circuits

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG201B, DG202B
Dual-In-Line, SOIC and TSSOP



Top View



TRUTH TABLE		
LOGIC	DG201B	DG202B
0	ON	OFF
1	OFF	ON

Note

- Logic "0" ≤ 0.8 V
  Logic "1" ≥ 2.4 V

ORDERING INFORMATION		
TEMP. RANGE	**PACKAGE**	**PART NUMBER**
-40 °C to +85 °C	16-pin Plastic DIP	DG201BDJ-E3
		DG202BDJ-E3
	16-pin narrow SOIC	DG201BDY-E3 DG201BDY-T1-E3
		DG202BDY-E3 DG202BDY-T1-E3
	16-pin TSSOP	DG201BDQ-E3 DG201BDQ-T1-E3
		DG202BDQ-E3 DG202BDQ-T1-E3

ABSOLUTE MAXIMUM RATINGS			
PARAMETER		**LIMIT**	**UNIT**
Voltages referenced, V+ to V-		44	V
GND		25	
Digital inputs [a], V_S, V_D		(V-) - 2 to (V+) + 2 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	
Storage temperature	(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	

Notes

a. 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
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

SCHEMATIC DIAGRAM (typical channel)

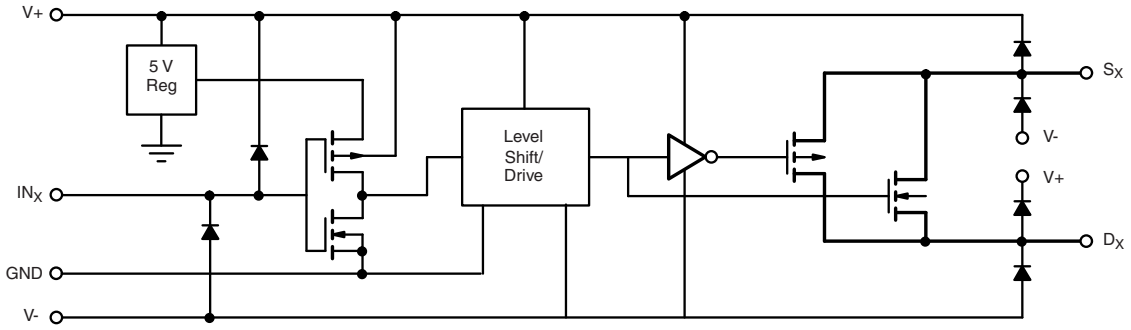


Fig. 1

SPECIFICATIONS [a]							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS SPECIFIED V+ = 15 V, V- = -15 V V_{IN} = 2.4 V, 0.8 V [f]	TEMP. [b]	TYP. [c]	D SUFFIX -40 °C to +85 °C		UNIT
					MIN. [d]	MAX. [d]	
Analog Switch							
Analog signal range [e]	V_{ANALOG}		Full	-	-15	15	V
Drain-source on-resistance	$R_{DS(on)}$	V_D = ± 10 V, I_S = 1 mA	Room	45	-	85	Ω
			Full	-	-	100	
$R_{DS(on)}$ match	$\Delta R_{DS(on)}$		Room	2	-	-	
Source off leakage current	$I_{S(off)}$	V_S = ± 14 V, V_D = ± 14 V	Room Full	± 0.01	-0.5 -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 -5	0.5 5	
Drain on leakage current	$I_{D(on)}$	V_S = V_D = ± 14 V	Room Full	± 0.02	-0.5 -10	0.5 10	
Digital Control							
Input voltage high	V_{INH}		Full	-	2.4	-	V
Input voltage low	V_{INL}		Full	-	-	0.8	
Input current	I_{INH} or I_{INL}	V_{INH} or V_{INL}	Full	-	-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	120	-	300	ns
Turn-off time	t_{off}		Room	65	-	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	-	-	
Power Supply							
Positive supply current	I+	V_{IN} = 0 or 5 V	Room	-	-	50	µA
			Full	-	-	100	
Negative supply current	I-		Room	-	-1	-	
			Full	-	-5	-	
Power supply range for continuous operation	V_{OP}		Full	-	± 4.5	± 22	V

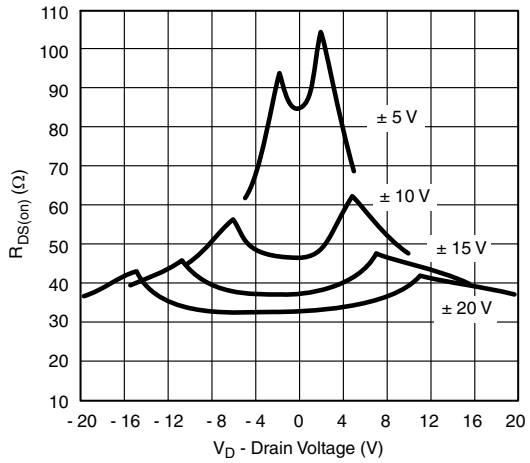
SPECIFICATIONS [a] (for Single Supply)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS UNLESS SPECIFIED** V+ = 12 V, V- = 0 V V_{IN} = 2.4 V, 0.8 V_f	**TEMP.** [b]	**TYP.** [c]	**D SUFFIX** -40 °C to +85 °C		**UNIT**
					MIN. [d]	**MAX.** [d]	
Analog Switch							
Analog signal range [e]	V_{ANALOG}		Full	-	0	12	V
Drain-source on-resistance	$R_{DS(on)}$	V_D = 3 V, 8 V, I_S = 1 mA	Room	90	-	160	Ω
			Full	-	-	200	Ω
Dynamic Characteristics							
Turn-on time	t_{on}	V_S = 8 V see switching time test circuit	Room	120	-	300	ns
Turn-off time	t_{off}		Room	60	-	200	
Charge injection	Q	C_L = 1 nF, V_{gen} = 6 V, R_{gen} = 0 Ω	Room	4	-	-	pC
Power Supply							
Positive supply current	I+	V_{IN} = 0 or 5 V	Room	-	-	50	µA
			Full	-	-	100	
Negative supply current	I-		Room	-	-1	-	
			Full	-	-5	-	
Power supply range for continuous operation	V_{OP}		Full	-	+4.5	+25	V

Notes

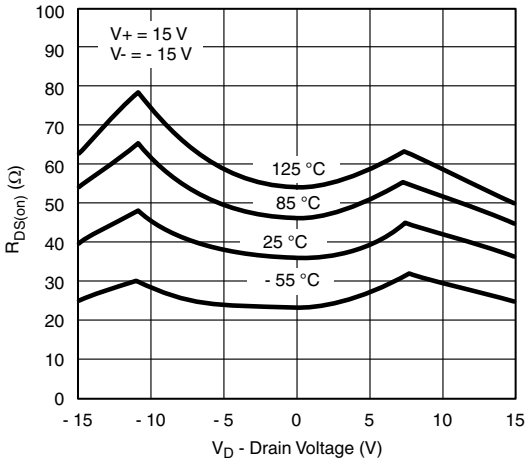
a. Refer to PROCESS OPTION FLOWCHART
b. Room = 25 °C, full = as determined by the operating temperature suffix
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing
d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet
e. Guaranteed by design, not subject to production test
f. V_{IN} = input voltage to perform proper function

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

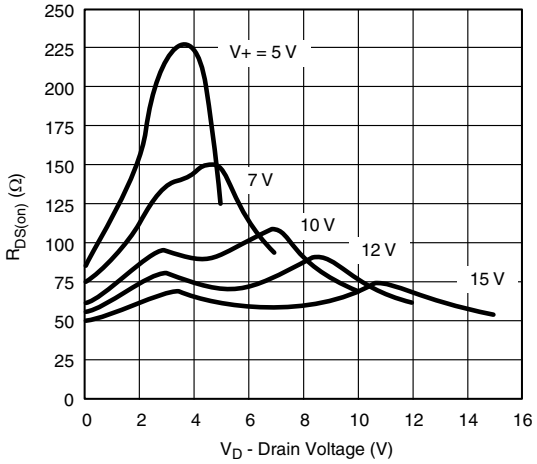
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



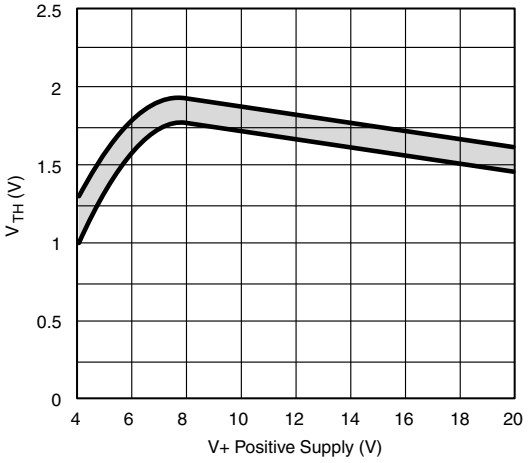
$R_{DS(on)}$ vs. V_D and Power Supply Voltages



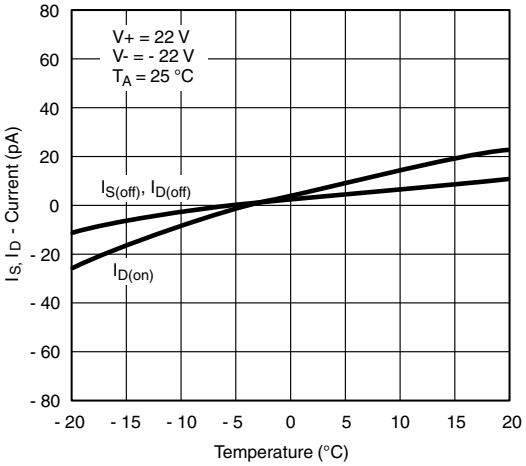
$R_{DS(on)}$ vs. V_D and Temperature



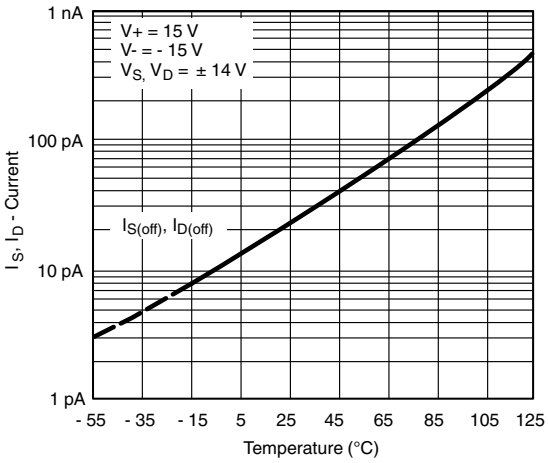
$R_{DS(on)}$ vs. V_D and Single Power Supply Voltages



Input Switching Threshold vs. Supply Voltage

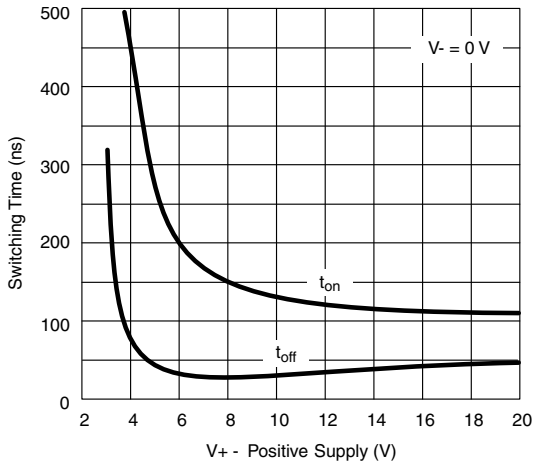


Leakage Currents vs. Analog Voltage

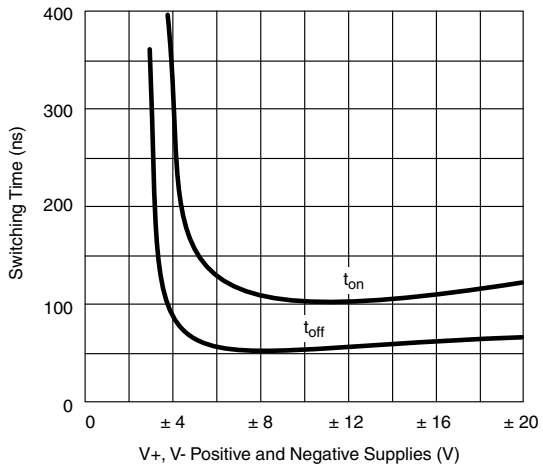


Leakage Currents vs. Temperature

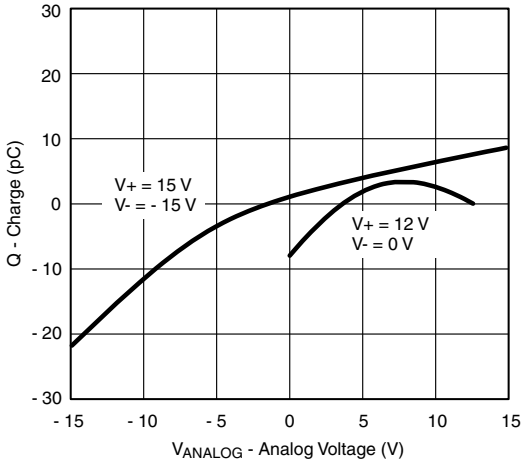
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



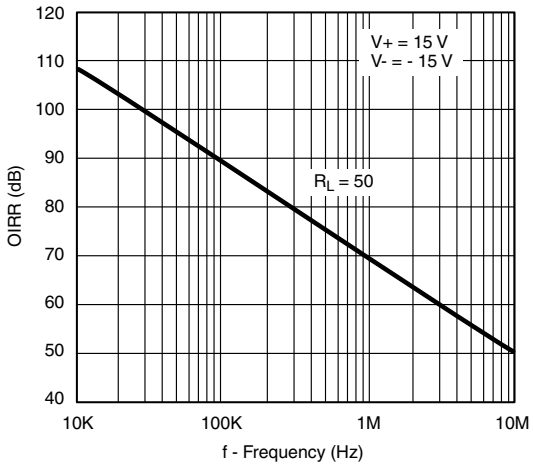
Switching Time vs. Single Supply Voltage



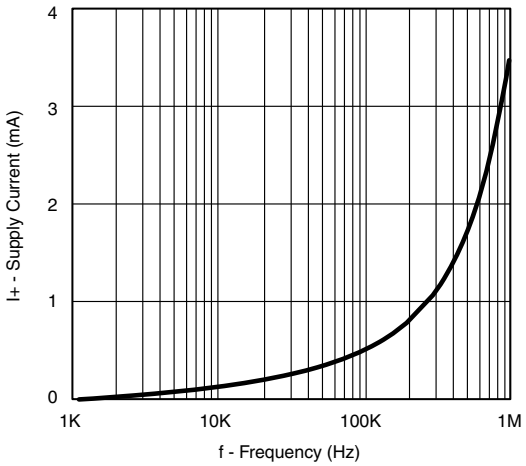
Switching Time vs. Power Supply Voltage



Q_S, Q_D - Charge Injection vs. Analog Voltage

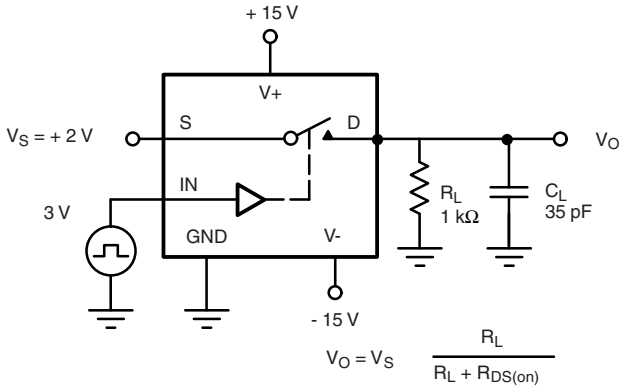


Off Isolation vs. Frequency



Supply Current vs. Switching Frequency

TEST CIRCUITS



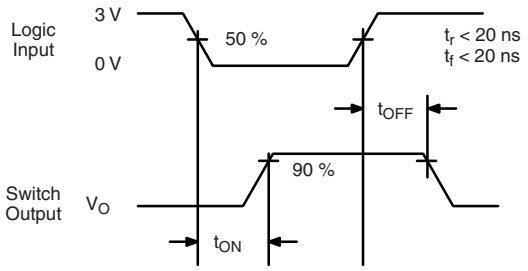


Fig. 2 - Switching Time

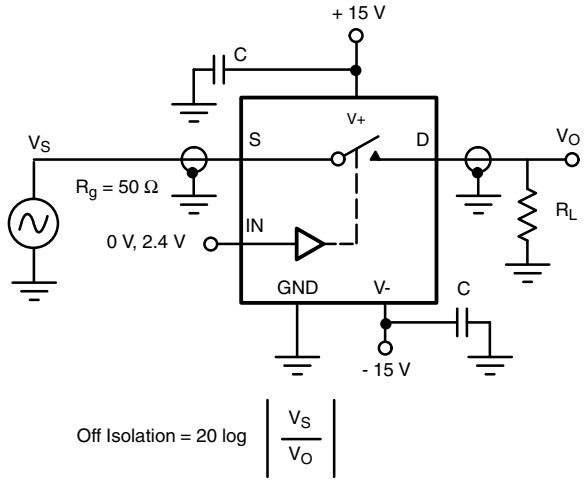


Fig. 3 - Off Isolation

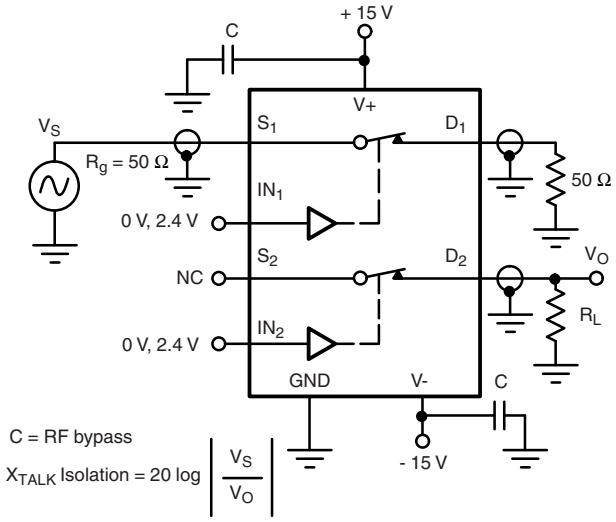
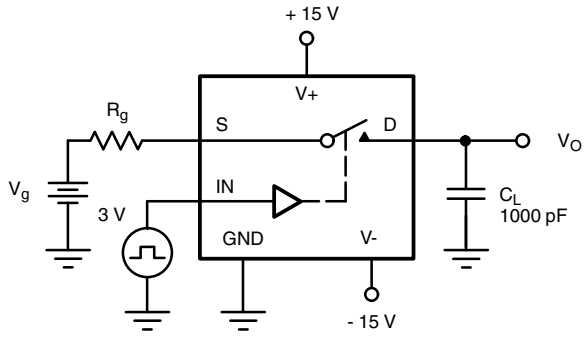
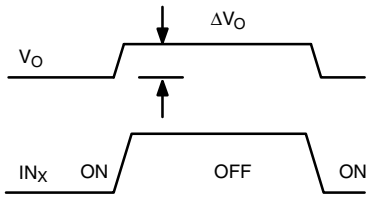


Fig. 4 - Channel-to-Channel Crosstalk





ΔV_O = measured voltage error due to charge injection
The charge injection in coulombs is Q = C_L x ΔV_O

Fig. 5 - Charge Injection

APPLICATIONS

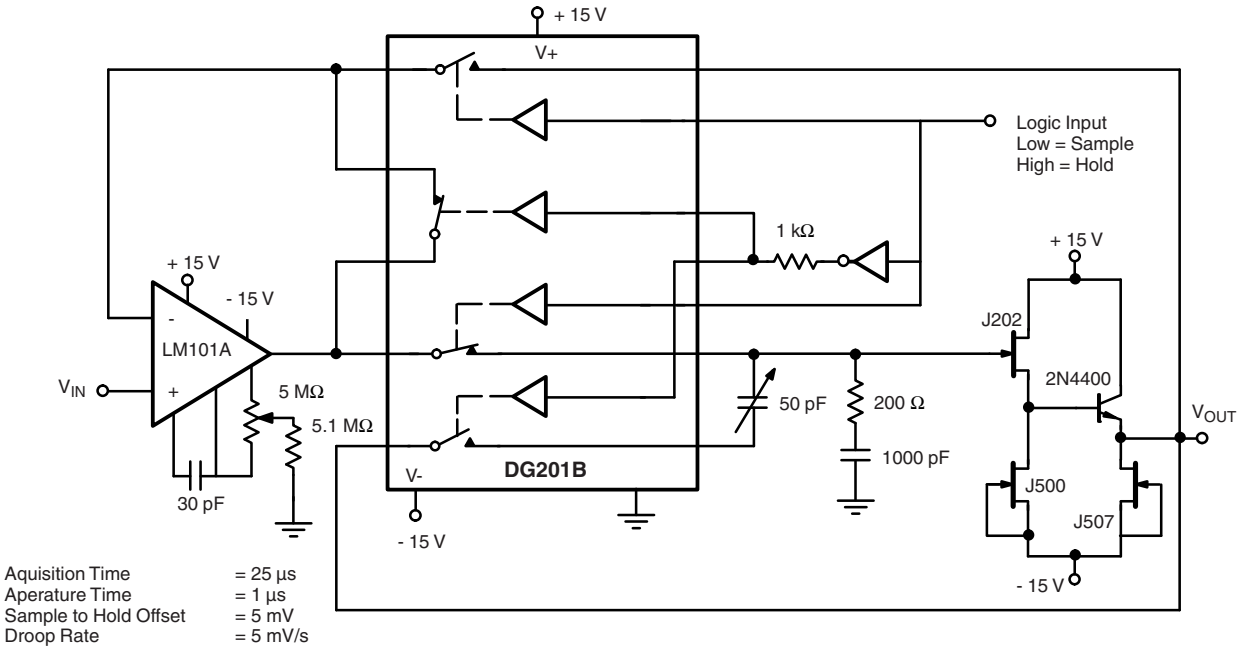
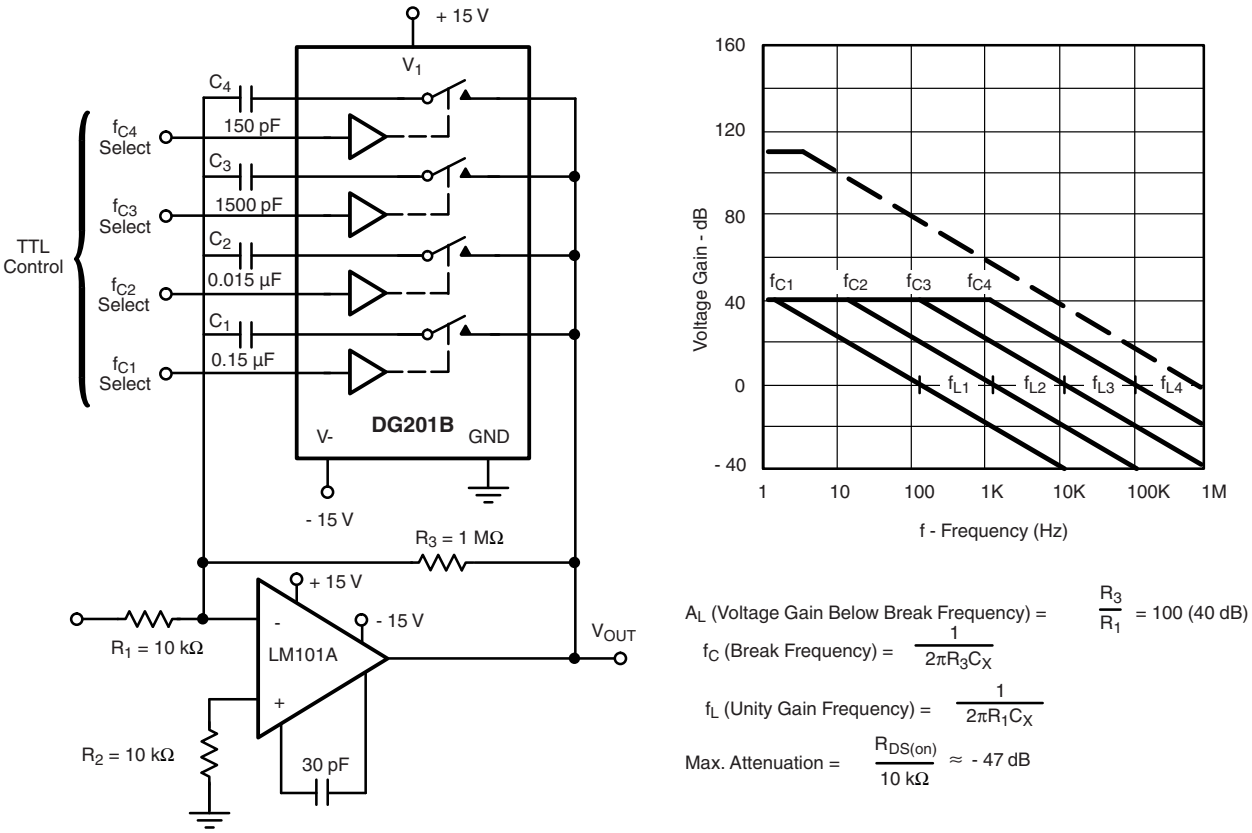


Fig. 6 - Sample-and-Hold



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

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

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

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

Fig. 7 - Active Low Pass Filter with Digitally Selected Break Frequency

APPLICATIONS

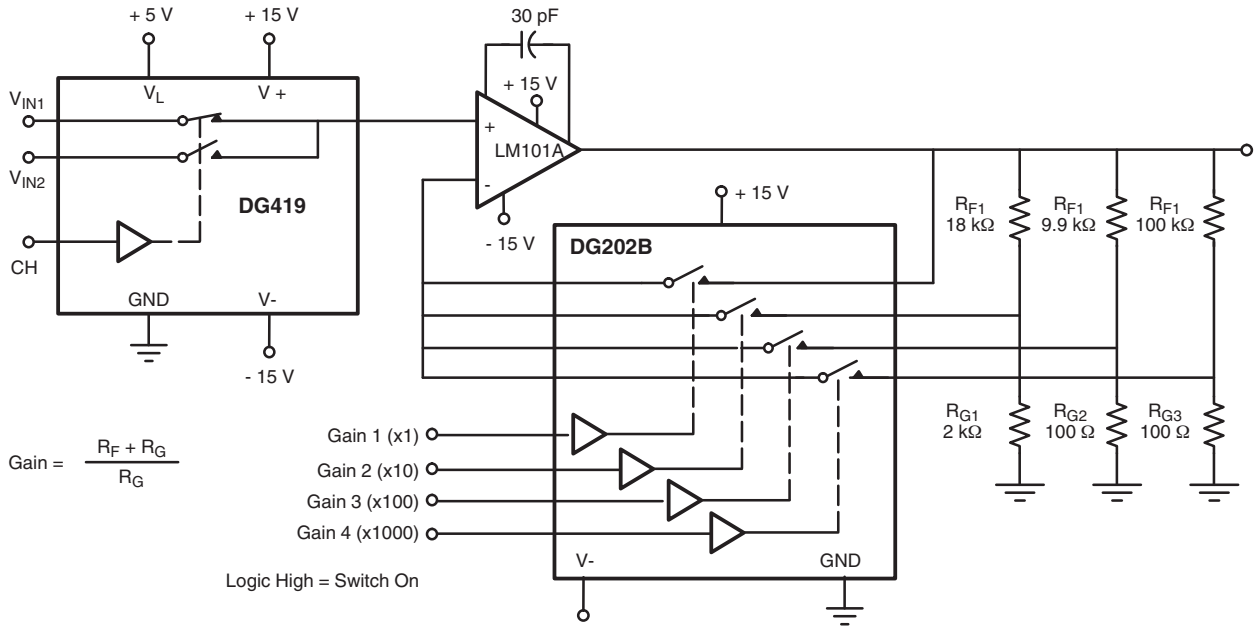


Fig. 8 - A Precision Amplifier with Digitally Programable Input and Gains

PRODUCT SUMMARY						
Part number	DG201B	DG201B	DG201B	DG202B	DG202B	DG202B
Status code	2	2	2	2	2	2
Configuration	SPST x 4, NC	SPST x 4, NC	SPST x 4, NC	SPST x 4, NO	SPST x 4, NO	SPST x 4, NO
Single supply min. (V)	5	5	5	5	5	5
Single supply max. (V)	36	36	36	36	36	36
Dual supply min. (V)	5	5	5	5	5	5
Dual supply max. (V)	22	22	22	22	22	22
On-resistance (Ω)	45	45	45	45	45	45
Charge injection (pC)	1	1	1	1	1	1
Source on capacitance (pF)	16	16	16	16	16	16
Source off capacitance (pF)	5	5	5	5	5	5
Leakage switch on typ. (nA)	0.02	0.02	0.02	0.02	0.02	0.02
Leakage switch off max. (nA)	0.5	0.5	0.5	0.5	0.5	0.5
-3 dB bandwidth (MHz)	-	-	-	-	-	-
Package	Plastic DIP-16	SO-16 (narrow) AS	TSSOP-16	Plastic DIP-16	SO-16 (narrow) AS	TSSOP-16
Functional circuit / applications	Multi purpose, instrumentation , medical and healthcare	Multi purpose, instrumentation , medical and healthcare	Multi purpose, instrumentation , medical and healthcare	Multi purpose, instrumentation , medical and healthcare	Multi purpose, instrumentation , medical and healthcare	Multi purpose, instrumentation, medical and healthcare
Interface	Parallel	Parallel	Parallel	Parallel	Parallel	Parallel
Single supply operation	Yes	Yes	Yes	Yes	Yes	Yes
Dual supply operation	Yes	Yes	Yes	Yes	Yes	Yes
Turn on time max. (ns)	120	120	120	120	120	120
Crosstalk and off isolation	-90	-90	-90	-90	-90	-90

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