Improved Quad CMOS Analog Switches

Features

- ±22-V Supply Voltage Rating
- 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}: < 200 ns
- Low Glitching—Q: 1 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 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 ±22-V input signals. An epitaxial layer prevents latchup.

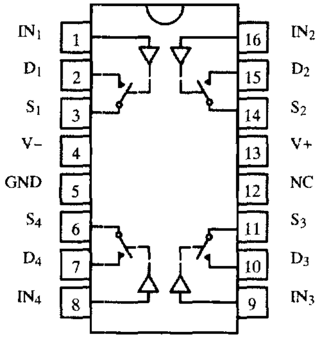
All devices feature true bi-directional performance in the on condition, and will block signals to the supply levels in the off condition.

The DG308B is a normally open switch and the DG309B is a normally closed switch. (See Truth Table.)

Functional Block Diagram and Pin Configuration

DG308B

Dual-In-Line, SOIC and TSSOP



Top View

Truth Table

Logic	DG308B	DG309B
0	OFF	ON
1	ON	OFF

Logic "0" ≤ 3.5V
Logic "1" ≥ 11 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

Updates to this data sheet may be obtained via facsimile by calling Siliconix FaxBack, 1-408-970-5600. Please request FaxBack document #70047.

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, 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:
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
e. Derate 12 mW/°C above 75°C

Specifications[a]

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 15 V, V– = –15 V V_{IN} = 11 V, 3.5 V[f]	Temp[b]	Typ[c]	A Suffix –55 to 125°C Min[d]	A Suffix Max[d]	D Suffix –40 to 85°C Min[d]	D Suffix Max[d]	Unit
Analog Switch									
Analog Signal Range[e]	V_{ANALOG}		Full		−15	15	−15	15	V
Drain-Source On-Resistance	$r_{DS(on)}$	$V_D = \pm 10$ V, I_S = 1 mA	Room Full	45		85 100		85 100	Ω
$r_{DS(on)}$ Match	$\Delta r_{DS(on)}$	$V_D = \pm 10$ V, I_S = 1 mA	Room	2					%
Source Off Leakage Current	$I_{S(off)}$	$V_S = \pm 14$ V, $V_D = \mp 14$ V	Room Full	±0.01	−0.5 −20	0.5 20	−0.5 −5	0.5 5	nA
Drain Off Leakage Current	$I_{D(off)}$	$V_D = \pm 14$ V, $V_S = \mp 14$ V	Room Full	±0.01	−0.5 −20	0.5 20	−0.5 −5	0.5 5	nA
Drain On Leakage Current	$I_{D(on)}$	$V_S = V_D = \pm 14$ V	Room Full	±0.02	−0.5 −40	0.5 40	−0.5 −10	0.5 10	nA
Digital Control									
Input Voltage High	V_{INH}		Full		11		11		V
Input Voltage Low	V_{INL}		Full			3.5		3.5	V
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 = 3 V, See Figure 2	Room			200		200	ns
Turn-Off Time	t_{OFF}	V_S = 3 V, See Figure 2	Room			150		150	ns
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	$C_{D(off)}$	V_S = 0 V, f = 1 MHz	Room	5					pF
Channel On Capacitance	$C_{D(on)}$	$V_D = V_S$ = 0 V, f = 1 MHz	Room	16					pF
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}	C_L = 15 pF, R_L = 50 Ω, V_S = 1 V_{RMS}, f = 100 kHz	Room	95					dB

Specifications[a]

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 15 V, V− = −15 V V_{IN} = 11 V, 3.5 V[f]	Temp[b]	Typ[c]	A Suffix −55 to 125°C Min[d]	 Max[d]	D Suffix −40 to 85°C Min[d]	 Max[d]	Unit
Power Supply									
Positive Supply Current	I+	V_{IN} = 0 or 15 V	Room Full			1 5		1 5	µA
Negative Supply Current	I−		Room Full		−1 −5		−1 −5		
Power Supply Range for Continuous Operation	V_{OP}		Full		±4	±22	±4	±22	V

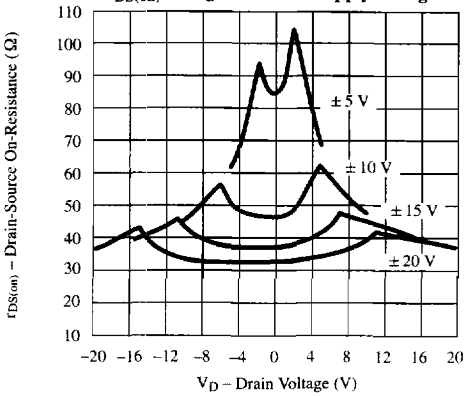
Specifications[a] for Single Supply

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 12 V, V− = 0 V V_{IN} = 11 V, 3.5 V[f]	Temp[b]	Typ[c]	A Suffix −55 to 125°C Min[d]	 Max[d]	D Suffix −40 to 85°C Min[d]	 Max[d]	Unit
Analog Switch									
Analog Signal Range[e]	V_{ANALOG}		Full		0	12	0	12	V
Drain-Source On-Resistance	$r_{DS(on)}$	V_D = 3 V, 8 V, I_S = 1 mA	Room Full	90		160 200		160 200	Ω
Dynamic Characteristics									
Turn-On Time	t_{ON}	V_S = 8 V, See Figure 2	Room			300		300	ns
Turn-Off Time	t_{OFF}		Room			200		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 12 V	Room Full			1 5		1 5	µA
Negative Supply Current	I−		Room Full		−1 −5		−1 −5		
Power Supply Range for Continuous Operation	V_{OP}		Full		4	44	4	44	V

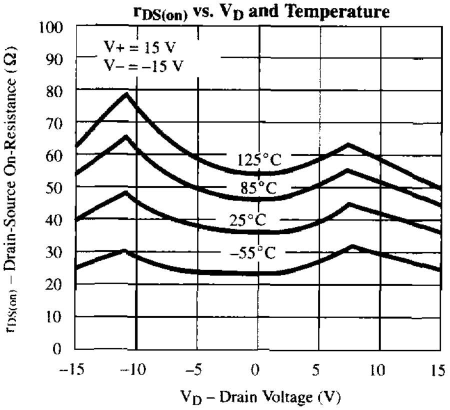
Notes:
a. Refer to PROCESS OPTION FLOWCHART.
b. Room = 25°C, Full = as determined by the operating temperature suffix.
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum and the most positive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

Typical Characteristics

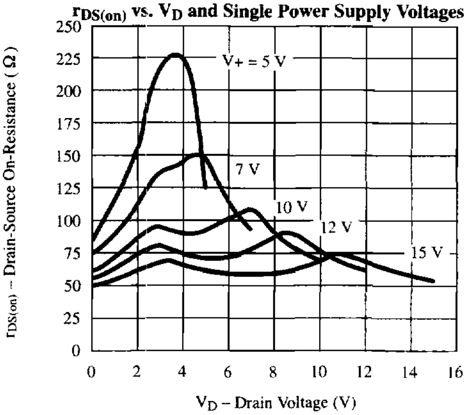
$r_{DS(on)}$ vs. V_D and Power Supply Voltages



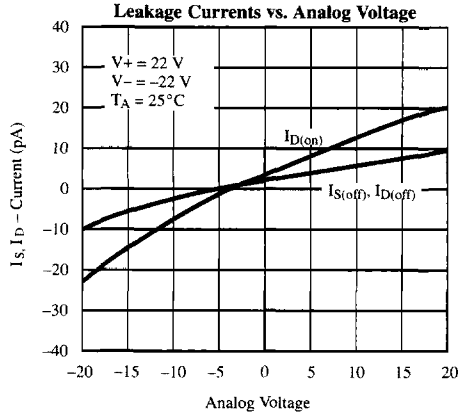
$r_{DS(on)}$ vs. V_D and Temperature



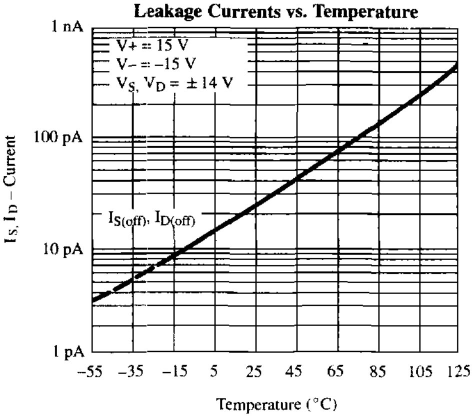
$r_{DS(on)}$ vs. V_D and Single Power Supply Voltages



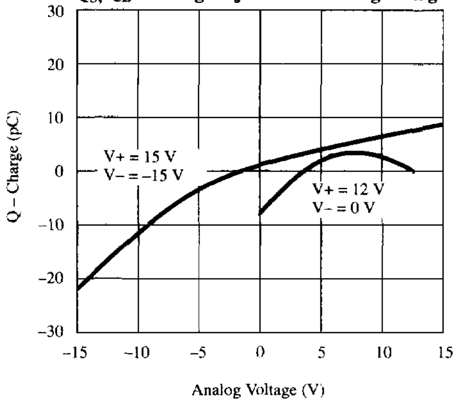
Leakage Currents vs. Analog Voltage



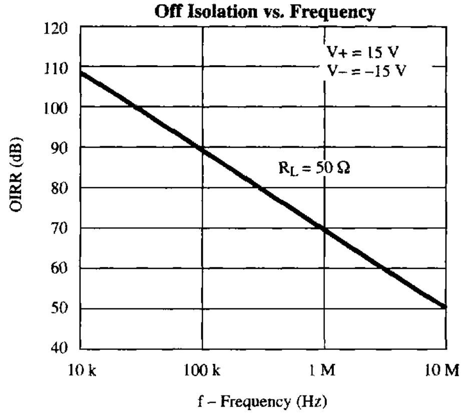
Leakage Currents vs. Temperature



Q_S, Q_D – Charge Injection vs. Analog Voltage



Typical Characteristics (Cont'd)



Schematic Diagram (Typical Channel)

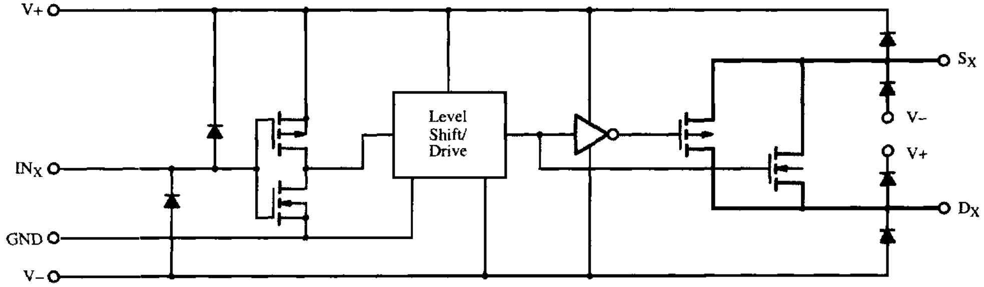


Figure 1.

Test Circuits

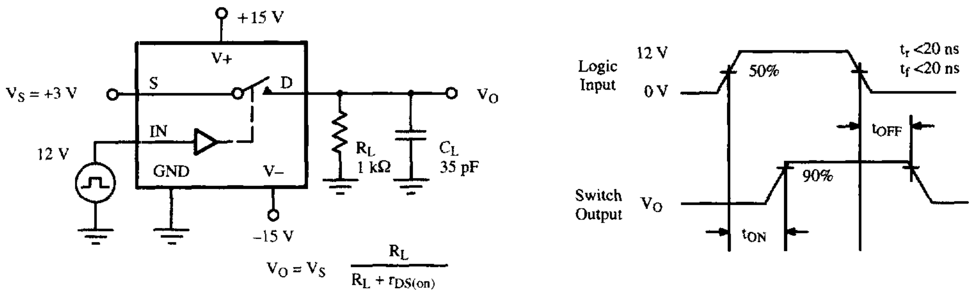


Figure 2. Switching Time

Test Circuits (Cont'd)

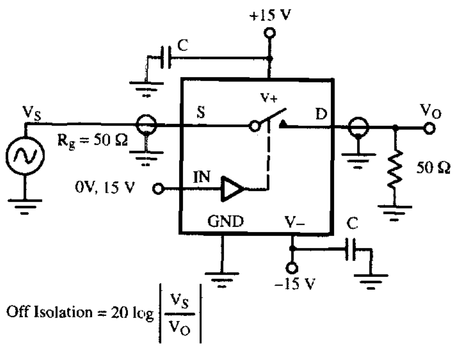


Figure 3. Off Isolation

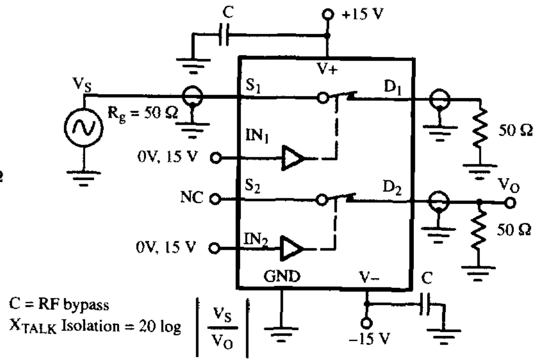


Figure 4. Channel-to-Channel Crosstalk

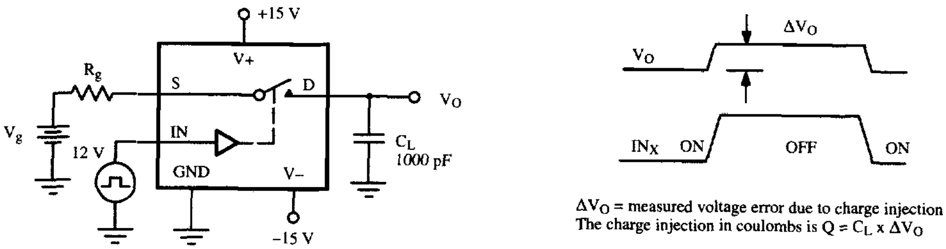


Figure 5. Charge Injection

Applications

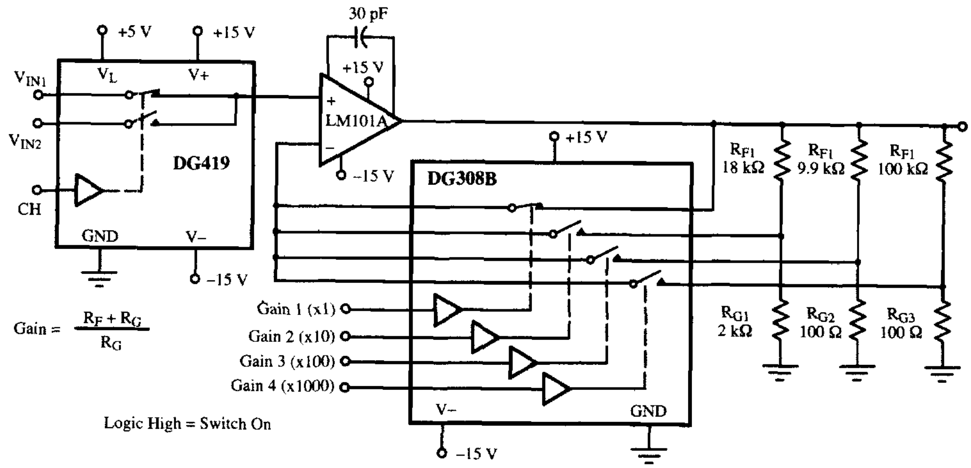
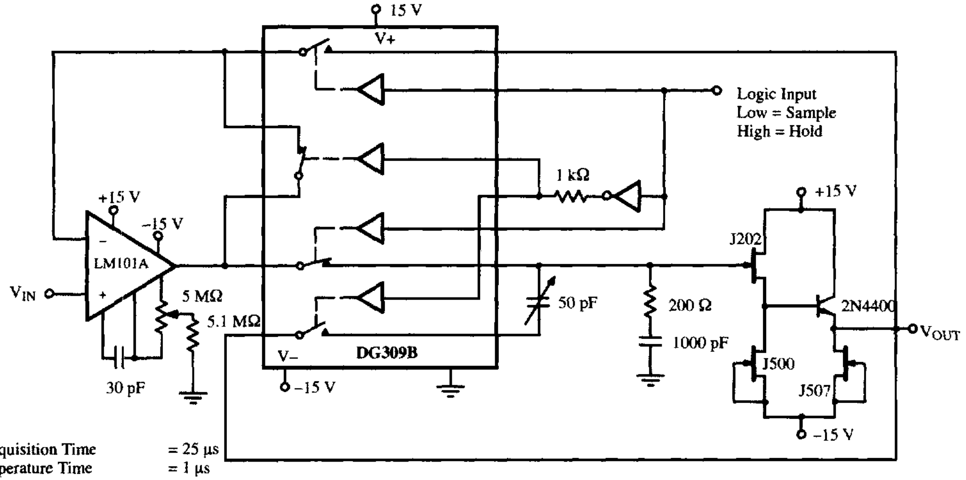


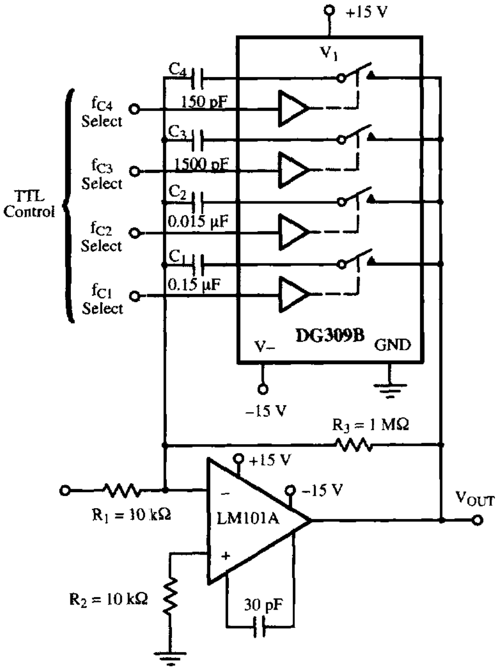
Figure 6. A Precision Amplifier with Digitally Programmable Inputs and Gains

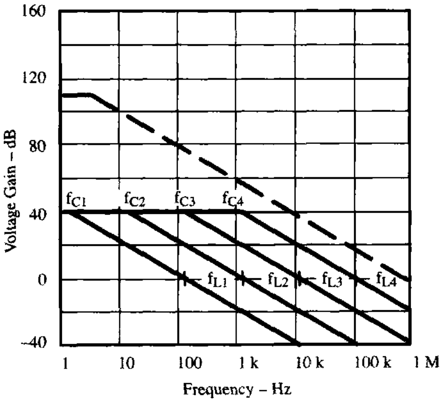
Applications (Cont'd)



Aquisition Time	= 25 µs
Aperature Time	= 1 µs
Sample to Hold Offset	= 5 mV
Droop Rate	= 5 mV/s

Figure 7. 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 = $\frac{r_{DS(on)}}{10\ k\Omega} \approx -40$ dB

Figure 8. Active Low Pass Filter with Digitally Selected Break Frequency