Improved Quad CMOS Analog Switches

DESCRIPTION

The DG308B, DG309B analog switches are highly improved versions of the industry-standard DG308A, DG309. 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 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).

BENEFITS

- Wide analog signal range
- Simple logic interface
- Higher accuracy
- Minimum transients
- Reduced power consumption
- Superior to DG308A, DG309
- Space savings (TSSOP)

FEATURES

Pb-free Available

RoHS* Available

- ± 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
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

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

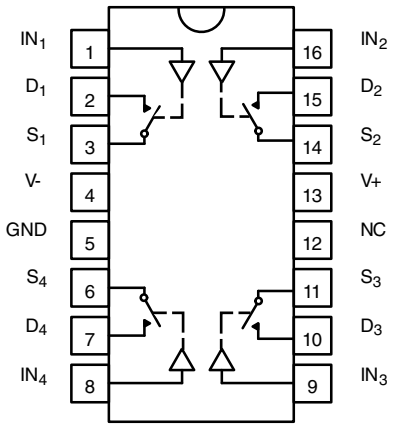
APPLICATIONS

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

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG308B, DG309B

Dual-In-Line, SOIC and TSSOP



Top View

TRUTH TABLE		
LOGIC	DG308B	DG309B
0	Off	On
1	On	Off

Note

- Logic "0" ≤ 3.5 V
  Logic "1" ≥ 11 V

ORDERING INFORMATION		
TEMP. RANGE	**PACKAGE**	**PART NUMBER**
-40 °C to +85 °C	16-pin narrow SOIC	DG308BDY-E3 DG308BDY-T1-E3
		DG309BDY-E3 DG309BDY-T1-E3
	16-pin TSSOP	DG308BDQ-E3 DG308BDQ-T1-E3
		DG309BDQ-E3 DG309BDQ-T1-E3
	16-pin plastic DIP	DG308BDJ-E3
		DG309BDJ-E3

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C, unless otherwise noted)			
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	(AK suffix)	-65 to +150	°C
	(DJ, DY and DQ suffix)	-65 to +125	
Power dissipation (package) [b]	16 pin plastic DIP [c]	470	mW
	16 pin narrow SOIC and TSSOP [d]	640	

Notes

a. Signals on SX, DX, or INX 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

SCHEMATIC DIAGRAM (typical channel)

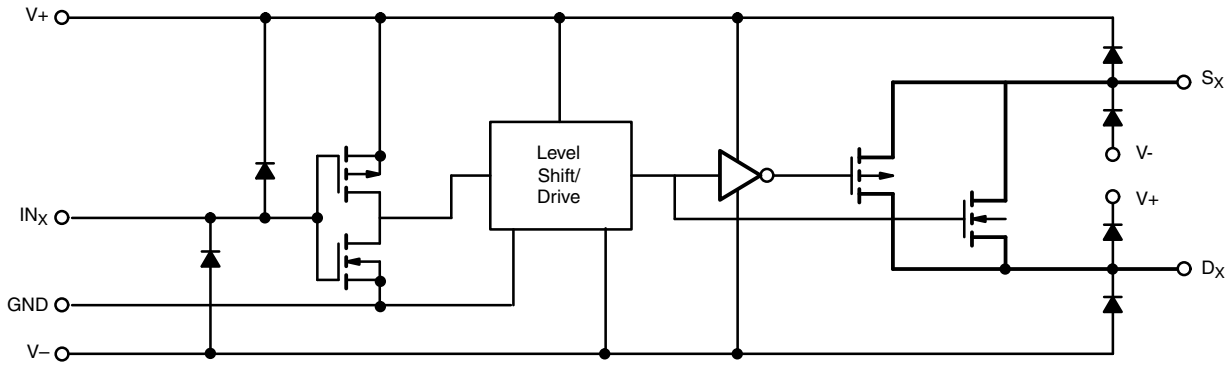


Fig. 1

SPECIFICATIONS

PARAMETER	SYMBOL	TEST CONDITIONS UNLESS SPECIFIED V+ = 15 V, V- = -15 V V_{IN} = 11 V, 3.5 V [f]	TEMP.[b]	TYP.[c]	A SUFFIX -55 °C to +125 °C		D SUFFIX -40 °C 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	45	-	85	-	85	Ω
			Full	-	-	100	-	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	± 0.01	-0.5	0.5	-0.5	0.5	nA
			Full	± 0.01	-20	20	-5	5	
Drain off leakage current	$I_{D(off)}$	V_D = ± 14 V, V_S = ± 14 V	Room	± 0.01	-0.5	0.5	-0.5	0.5	
			Full	± 0.01	-20	20	-5	5	
Drain on leakage current	$I_{D(on)}$	V_S = V_D = ± 14 V	Room	± 0.02	-0.5	0.5	-0.5	0.5	
			Full	± 0.02	-40	40	-10	10	
Digital Control									
Input voltage high	V_{INH}		Full	-	11	-	11	-	V
Input voltage low	V_{INL}		Full	-	-	3.5	-	3.5	
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 Fig. 9	Room	-	-	200	-	200	ns
Turn-off time	t_{OFF}		Room	-	-	150	-	150	
Charge injection	Q	C_L = 1000 pF, V_{gen} = 0 V, R_{gen} = 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	O_{IRR}	C_L = 15 pF, R_L = 50 Ω, V_S = 2 V_{RMS}, f = 100 kHz	Room	90	-	-	-	-	dB
Channel to channel crosstalk	X_{TALK}		Room	95	-	-	-	-	dB
Power Supply									
Positive supply current	I+	V_{IN} = 0 V or 15 V	Room	-	-	1	-	1	µA
			Full	-	-	5	-	5	
Negative supply current	I-		Room	-	-1	-	-1	-	
			Full	-	-5	-	-5	-	
Power supply range for continuous operation	V_{OP}		Full	-	± 4	± 22	± 4	± 22	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

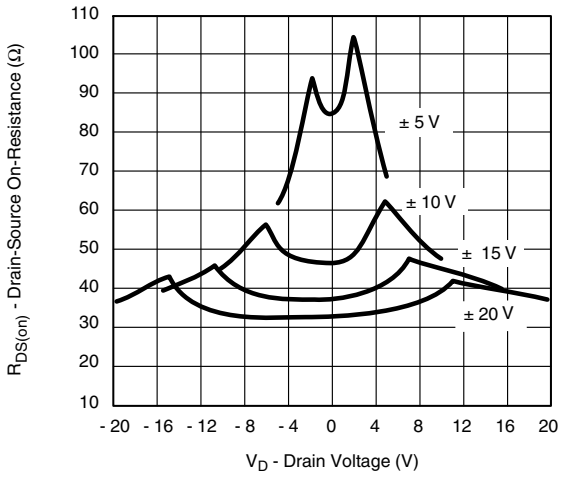
SPECIFICATIONS (for Single Supply)									
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS SPECIFIED V+ = 12 V, V- = 0 V V_{IN} = 11 V, 3.5 V [f]	TEMP.[a]	TYP. [c]	A SUFFIX -55 °C to +125 °C		D SUFFIX -40 °C to +85 °C		UNIT
					MIN. [b]	MAX. [b]	MIN. [b]	MAX. [b]	
Analog Switch									
Analog signal range [d]	V_{ANALOG}		Full	- -	0 -	12 -	0 -	12 -	V
Drain-source on-resistance	$R_{DS(on)}$	VD = 3 V, 8 V, IS = 1 mA	Room Full	90 -	- -	160 200	- -	160 200	Ω
Dynamic Characteristics									
Turn-on time	t_{ON}	V_S = 8 V, see Fig. 1	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 V or 5 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

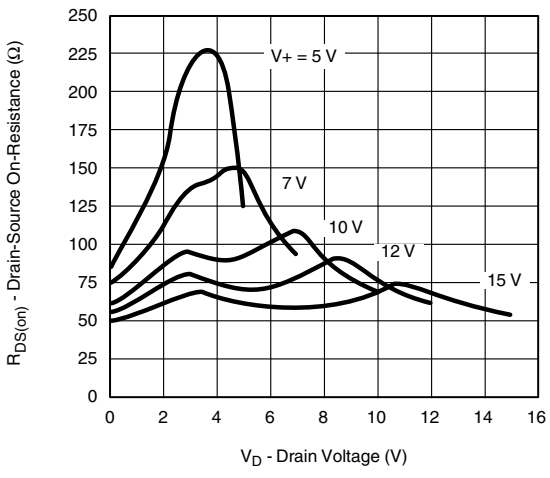
a. Refer to PROCESS OPTION FLOWCHART
b. Room = 25 °C, Full = as determined by the operating temperature suffix
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing
d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum,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

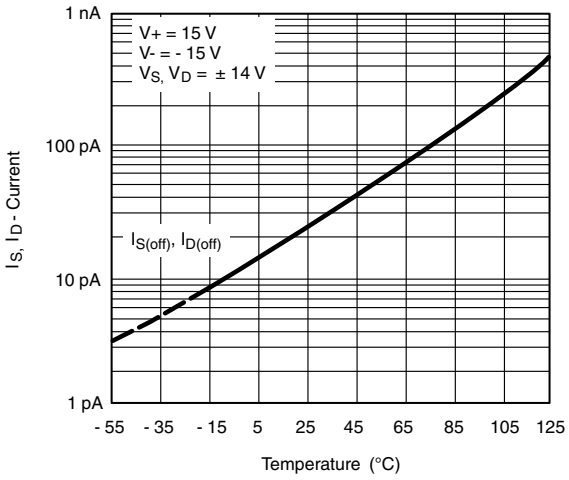


$R_{DS(on)}$ vs. V_D and Power Supply Voltages

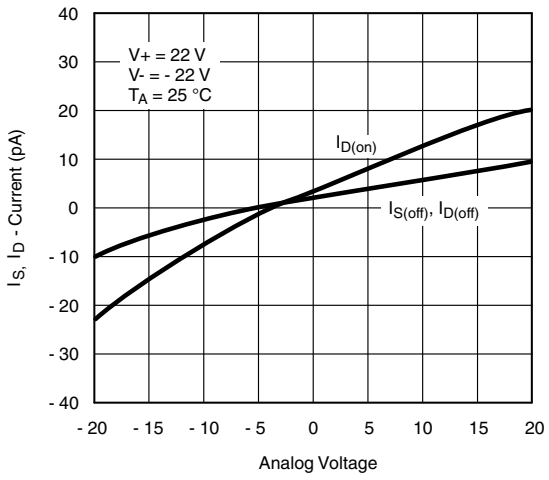


$R_{DS(on)}$ vs. V_D and Single Power Supply Voltages

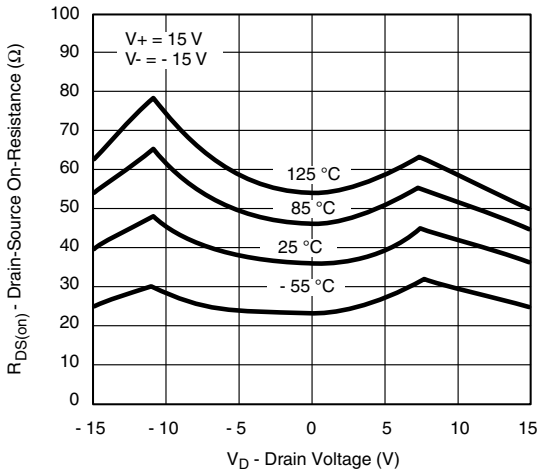
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



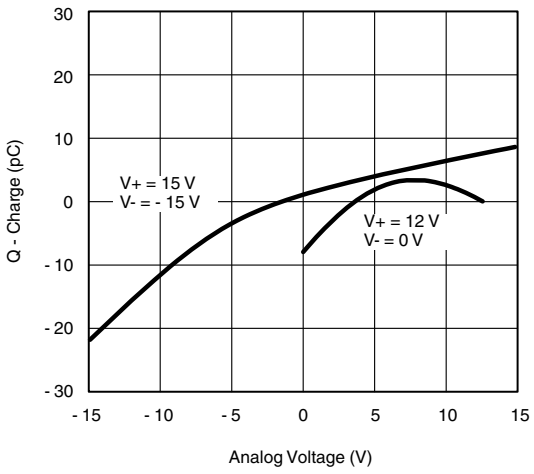
Leakage Currents vs. Temperature



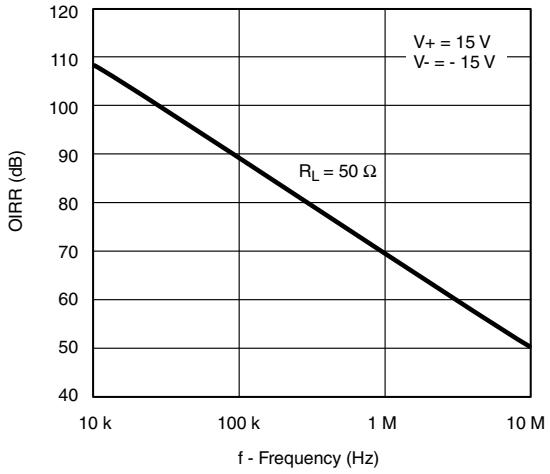
Leakage Currents vs. Analog Voltage



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

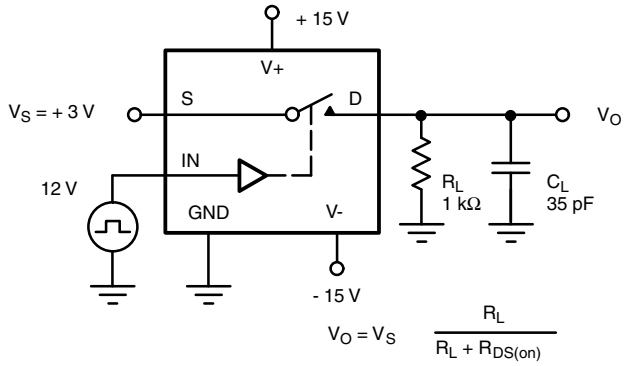


QS, QD - Charge Injection vs. Analog Voltage



Off Isolation vs. Frequency

TEST CIRCUITS



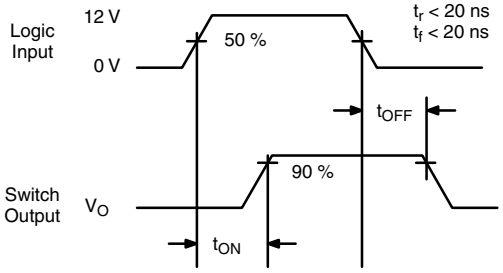


Fig. 2 - Switching Time

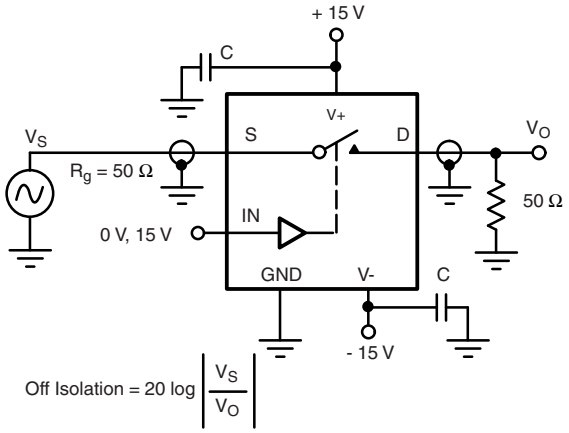


Fig. 3 - Off Isolation

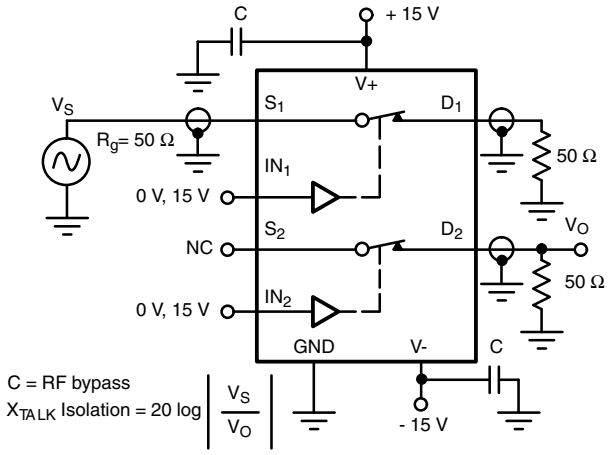
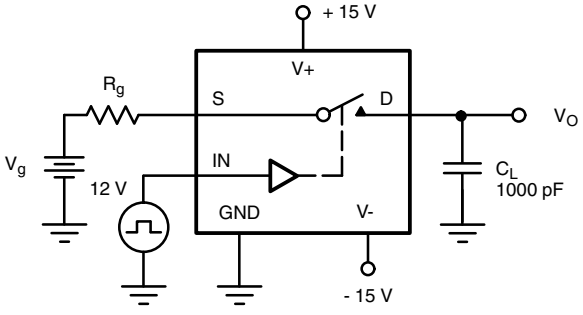
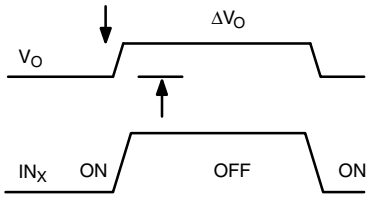


Fig. 4 - Channel to Channel Crosstalk





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

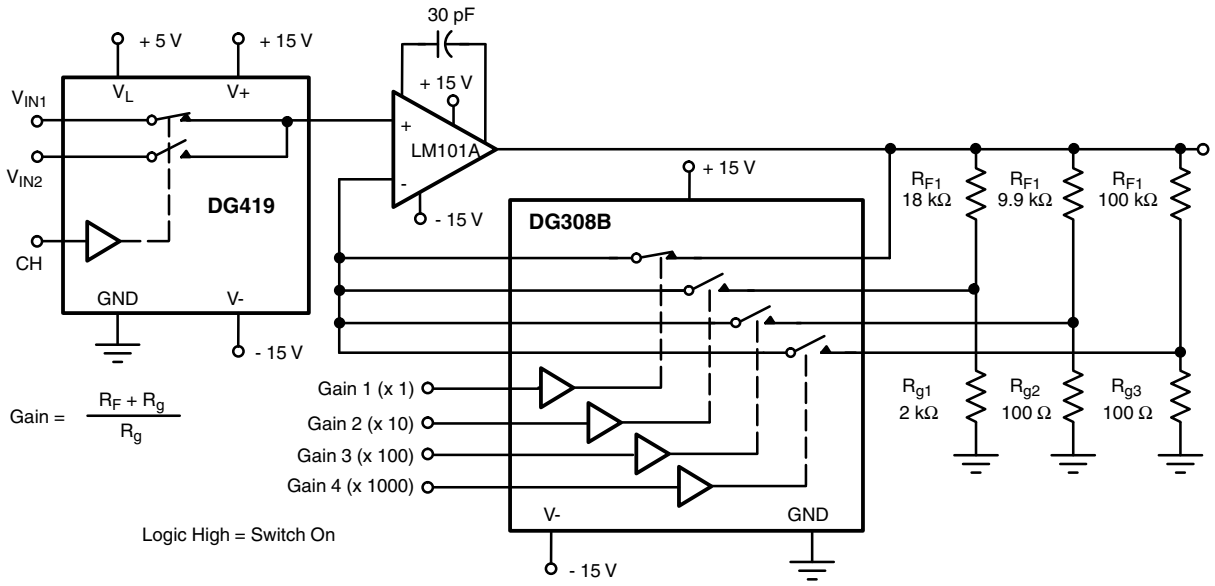


Fig. 6 - A Precision Amplifier with Digitally Programmable Inputs and Gains

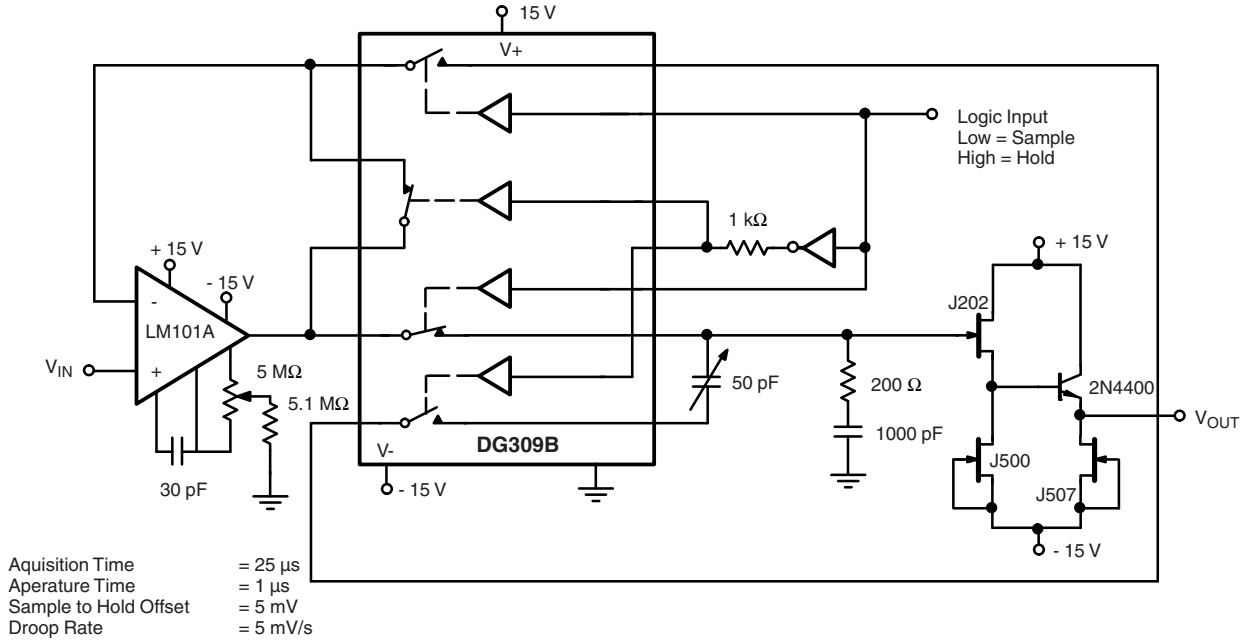
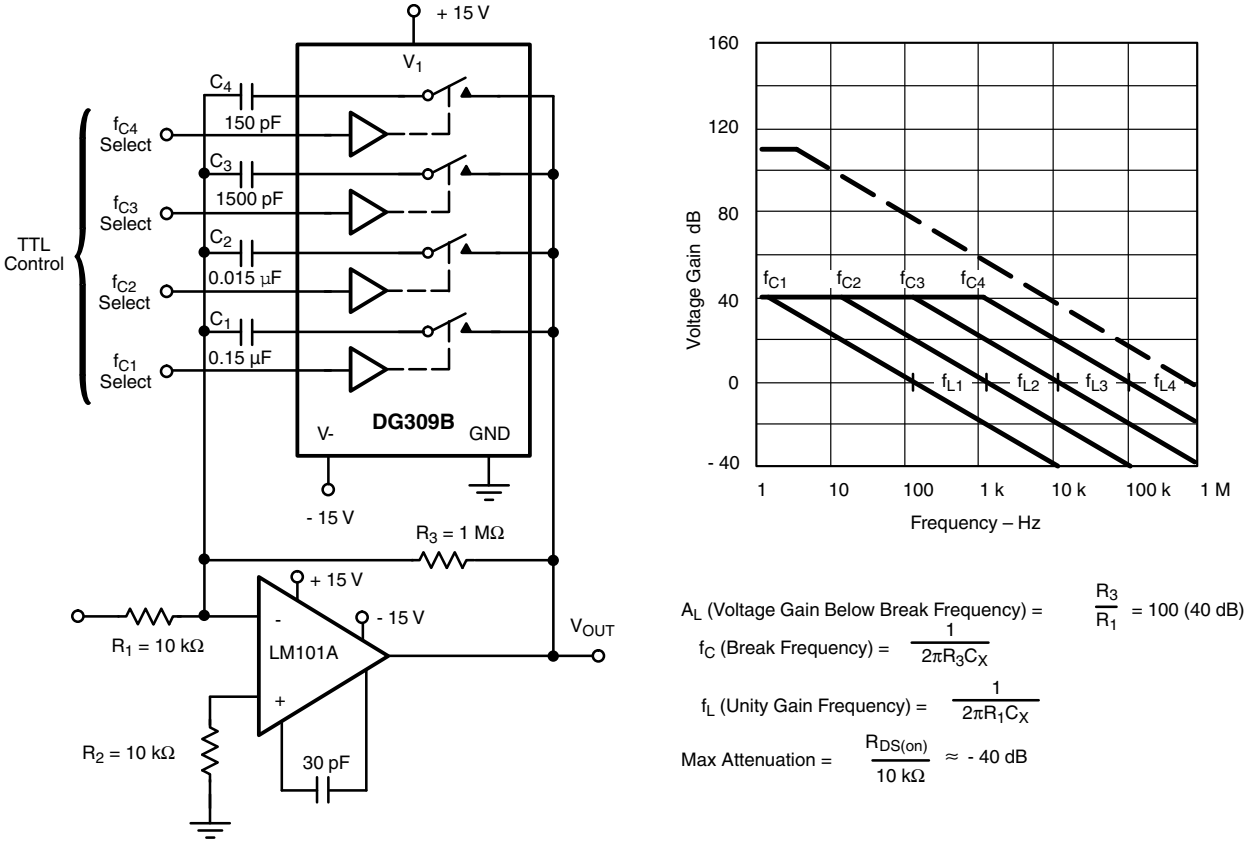


Fig. 7 - Sample-and-Hold

APPLICATIONS



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

Fig. 8 - Active Low Pass Filter with Digitally Selected Break Frequency

PRODUCT SUMMARY						
Part number	DG308B	DG308B	DG308B	DG309B	DG309B	DG309B
Status code	2	2	2	2	2	2
Configuration	SPST x 4, NO	SPST x 4, NO	SPST x 4, NO	SPST x 4, NC	SPST x 4, NC	SPST x 4, NC
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)	-	-	-	-	-	-
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	SO-16 (narrow) AS	TSSOP-16	Plastic DIP-16	SO-16 (narrow) AS	TSSOP-16	Plastic DIP-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)	200	200	200	200	200	200
Crosstalk and off isolation	-90	-90	-90	-90	-90	-90

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