Improved Quad CMOS Analog Switches

DESCRIPTION

The DG211B, DG212B analog switches are highly improved versions of the industry-standard DG211, DG212. 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 DG211B and DG212B can handle up to ± 22 V, 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 levels in the off condition.

The DG211B is a normally closed switch and the DG212B is a normally open switch (see Truth Table).

BENEFITS

- Wide analog signal range
- Simple logic interface
- Higher accuracy
- Minimum transients
- Reduced power consumption
- Superior to DG211, DG212
- Space savings (TSSOP)

FEATURES

Pb-free Available

RoHS* Available

- ± 22 V supply voltage rating
- TTL and CMOS compatible logic
- Low on-resistance - $R_{DS(on)}$: 50 Ω
- Low leakage - $I_{D(on)}$: 20 pA
- Single supply operation possible
- Extended temperature range
- Fast switching - t_{on}: 120 ns
- Low charge injection - Q: 1 pC
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Note

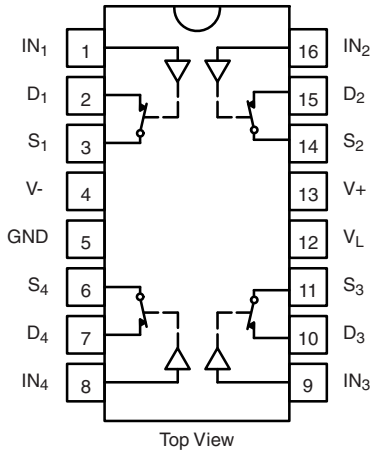
* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

APPLICATIONS

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

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG211B
Dual-In-Line, SOIC and TSSOP



Top View

TRUTH TABLE		
LOGIC	DG211B	DG212B
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 narrow SOIC	DG211BDY-E3 DG211BDY-T1-E3
		DG212BDY-E3 DG212BDY-T1-E3
	16-pin TSSOP	DG211BDQ-E3 DG211BDQ-T1-E3
		DG212BDQ-E3 DG212BDQ-T1-E3
	16-pin plastic DIP	DG211BDJ-E3
		DG212BDJ-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		-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 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

SCHEMATIC DIAGRAM (typical channel)

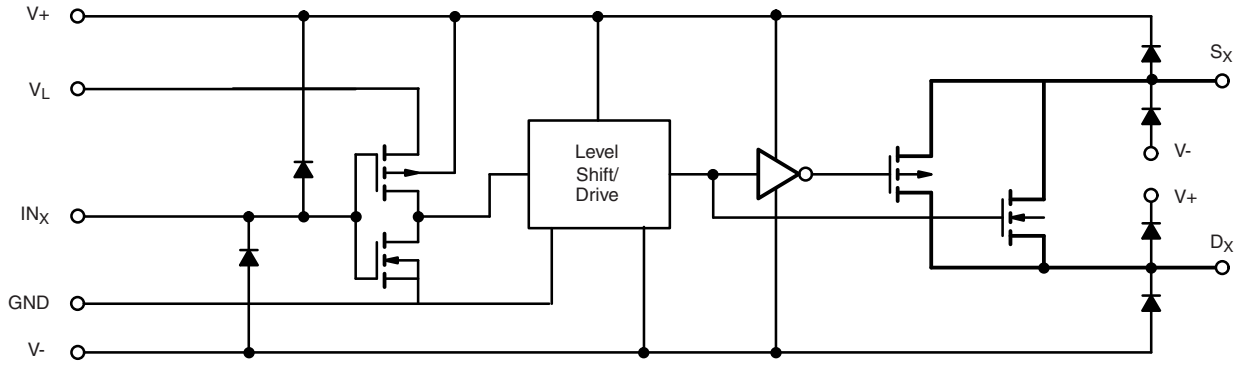


Fig. 1

SPECIFICATIONS

PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 15 V, V- = -15 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V [e]	TEMP.[a]	D SUFFIX -40 °C to +85 °C			UNIT
				MIN. [b]	TYP. [c]	MAX. [b]	
Analog Switch							
Analog signal range [d]	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	-0.5	± 0.01	0.5	nA
			Full	-	± 0.01	5	
Drain off leakage current	$I_{D(off)}$	V_D = ± 14 V, V_S = ± 14 V	Room	-0.5	± 0.01	0.5	
			Full	-5	± 0.01	5	
Drain on leakage current	$I_{D(on)}$	V_S = V_D = ± 14 V	Room	-0.5	± 0.02	0.5	
			Full	-10	± 0.02	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 = 10 V, see Fig. 9	Room	-	-	300	ns
Turn-off time	t_{off}		Room	-	-	200	
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 = 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 V or 5 V	Room	-	-	10	µA
			Full	-	-	50	
Negative supply current	I-		Room	- 10	-	-	
			Full	- 50	-	-	
Logic supply current	I_L		Room	-	-	10	
			Full	-	-	50	
Power supply range for continuous operation	V_{OP}		Full	± 4.5	-	± 22	V

SPECIFICATIONS (for Single Supply)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS UNLESS OTHERWISE SPECIFIED** V+ = 12 V, V- = 0 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V [e]	**TEMP.**[a]	**D SUFFIX** -40 °C to +85 °C			**UNIT**
				MIN. [b]	**TYP.** [c]	**MAX.** [b]	
Analog Switch							
Analog signal range [d]	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	-	90	200	
Dynamic Characteristics							
Turn-on time	t_{ON}	V_S = 8 V, see Fig. 1	Room	-	-	300	ns
Turn-off time	t_{OFF}		Room	-	-	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	-	-	10	µA
			Full	-	-	50	
Negative supply current	I-		Room	- 10	-	-	
			Full	- 50	-	-	
Logic supply current	I_L	V_S = 8 V, see Fig. 1	Room	-	-	10	
			Full	-	-	50	
Power supply range for continuous operation	V_{OP}		Full	+ 4.5	-	+ 25	V

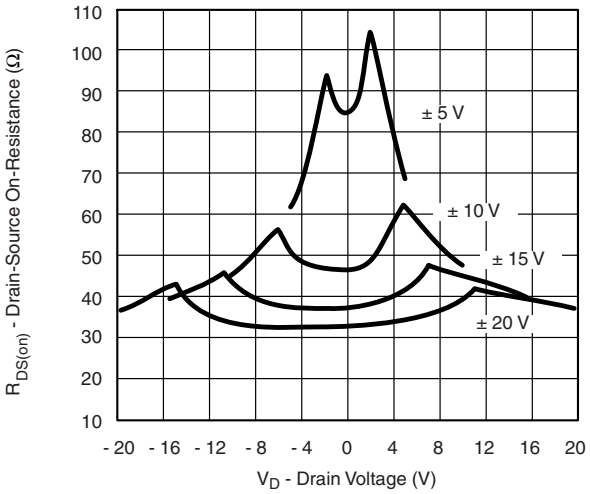
Notes

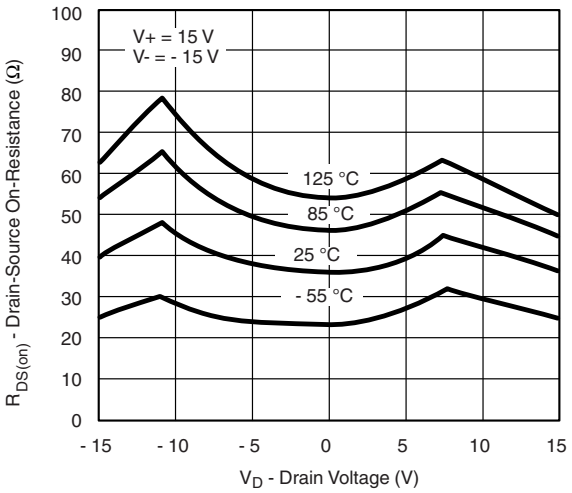
a. Room = 25 °C, Full = as determined by the operating temperature suffix
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing
d.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

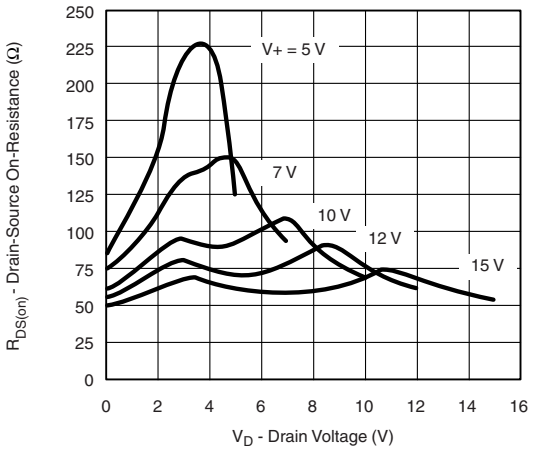
$R_{DS(on)}$ vs. V_D and Power Supply Voltages



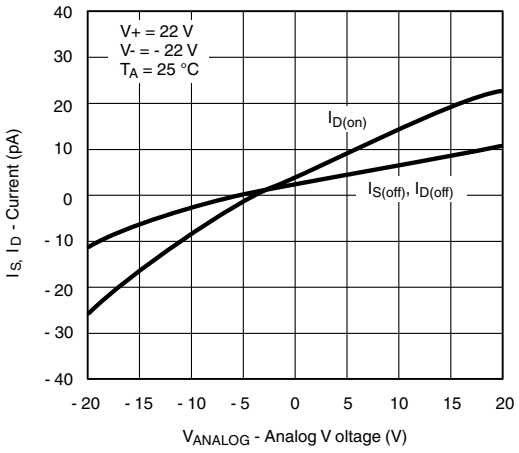


$R_{DS(on)}$ vs. V_D and Temperature

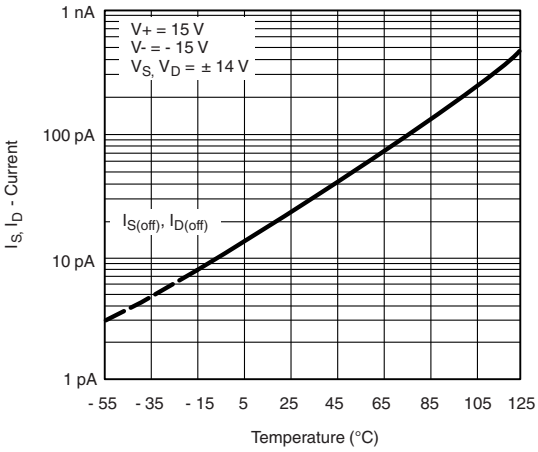
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



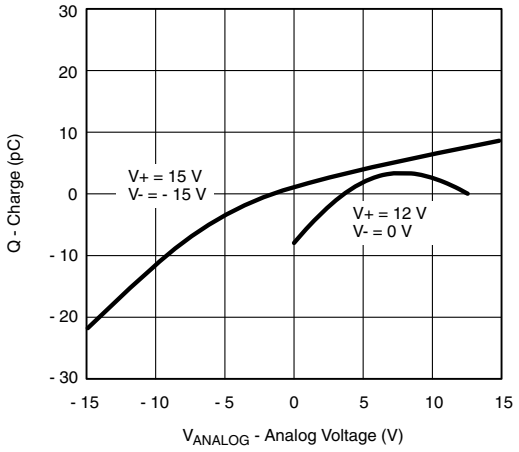
$R_{DS(on)}$ vs. V_D and Single Power Supply Voltages



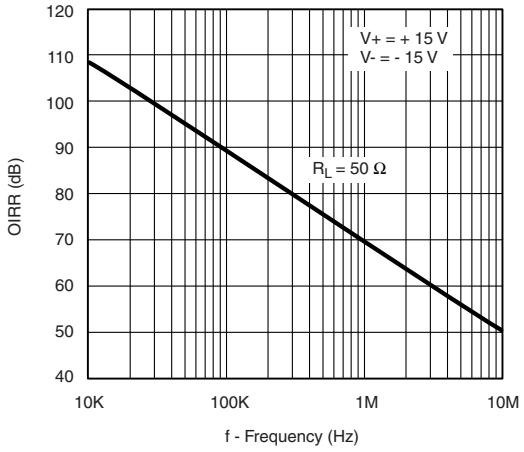
Leakage Current vs. Temperature



Leakage Current vs. Temperature

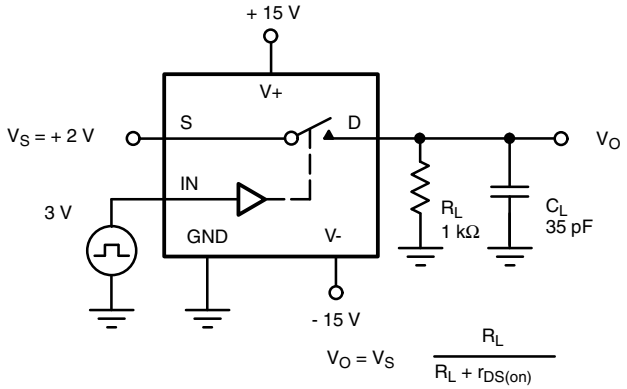


Q_S, Q_D - Charge Injection vs. Analog Voltage



Off Isolation vs. Frequency

TEST CIRCUITS



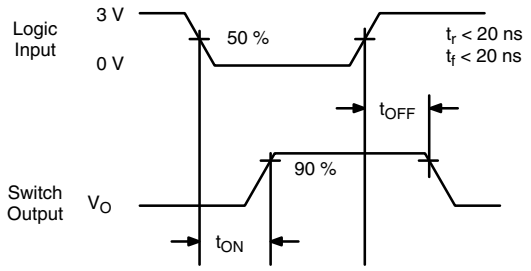


Fig. 2 - Switching Time

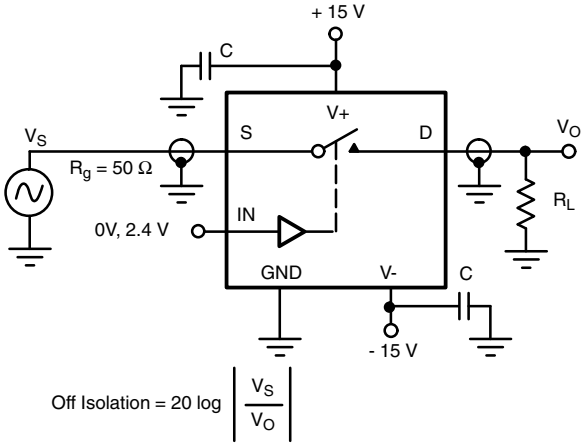


Fig. 3 - Off Isolation

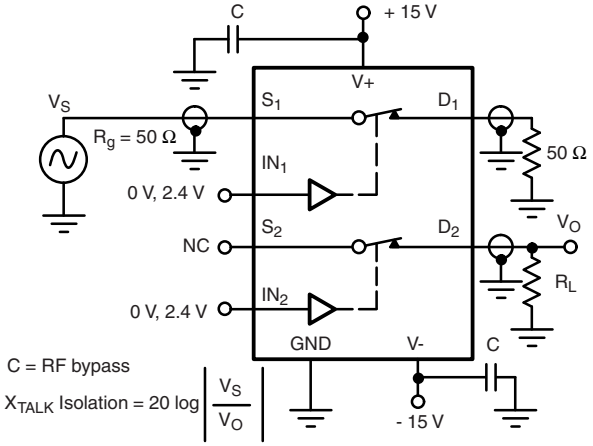
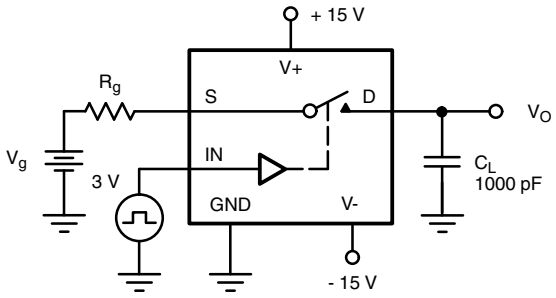
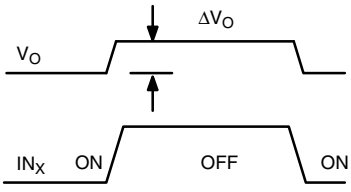


Fig. 4 - Channel to Channel Crosstalk





ΔV_O = measured voltage error due to charge injection
The charge injection in coulombs is $Q = C_L \times \Delta V_O$

Fig. 5 - Charge Injection

APPLICATIONS

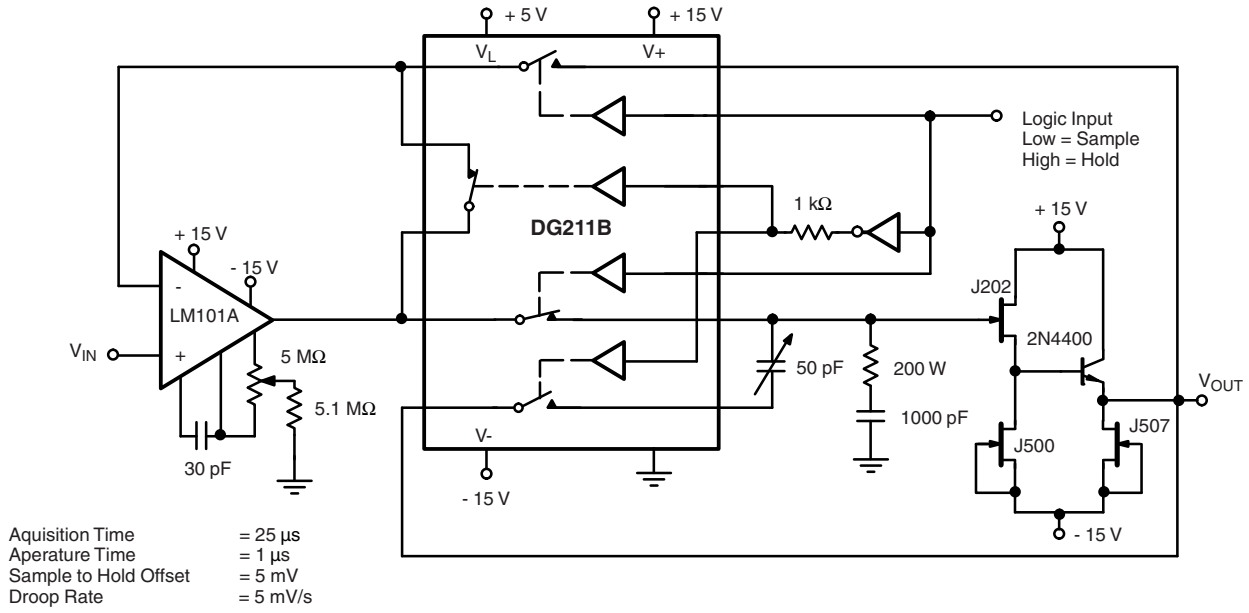
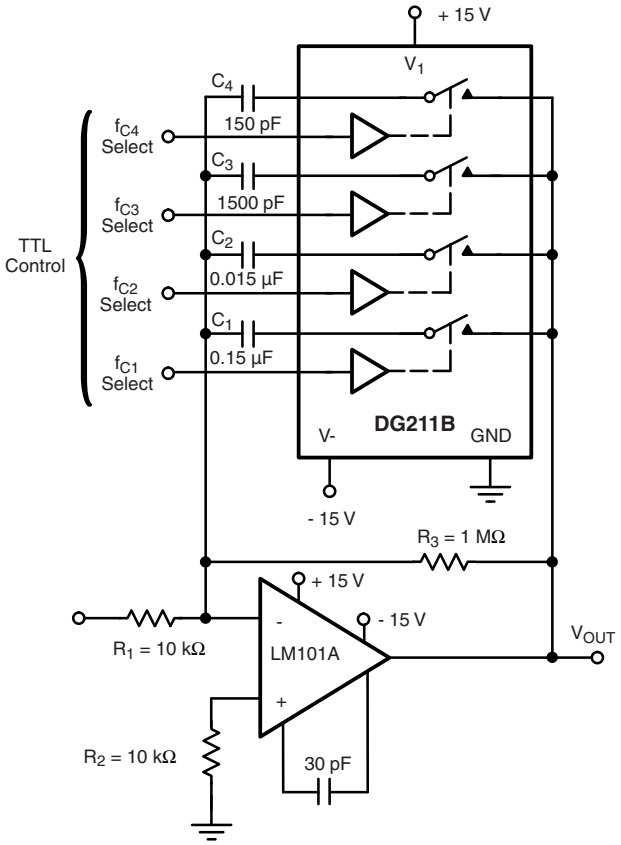
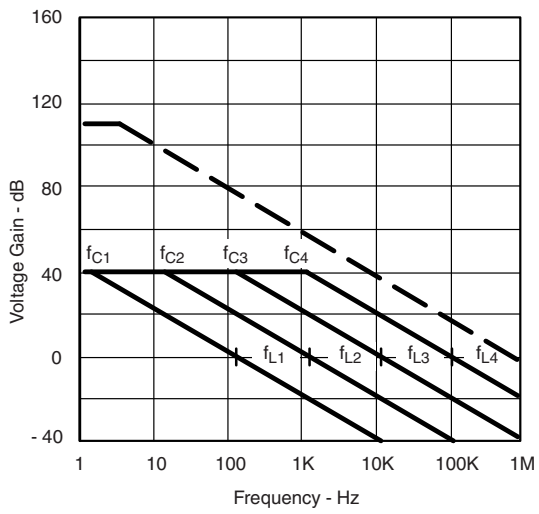


Fig. 6 - Sample and Hold





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

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

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

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

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

APPLICATIONS

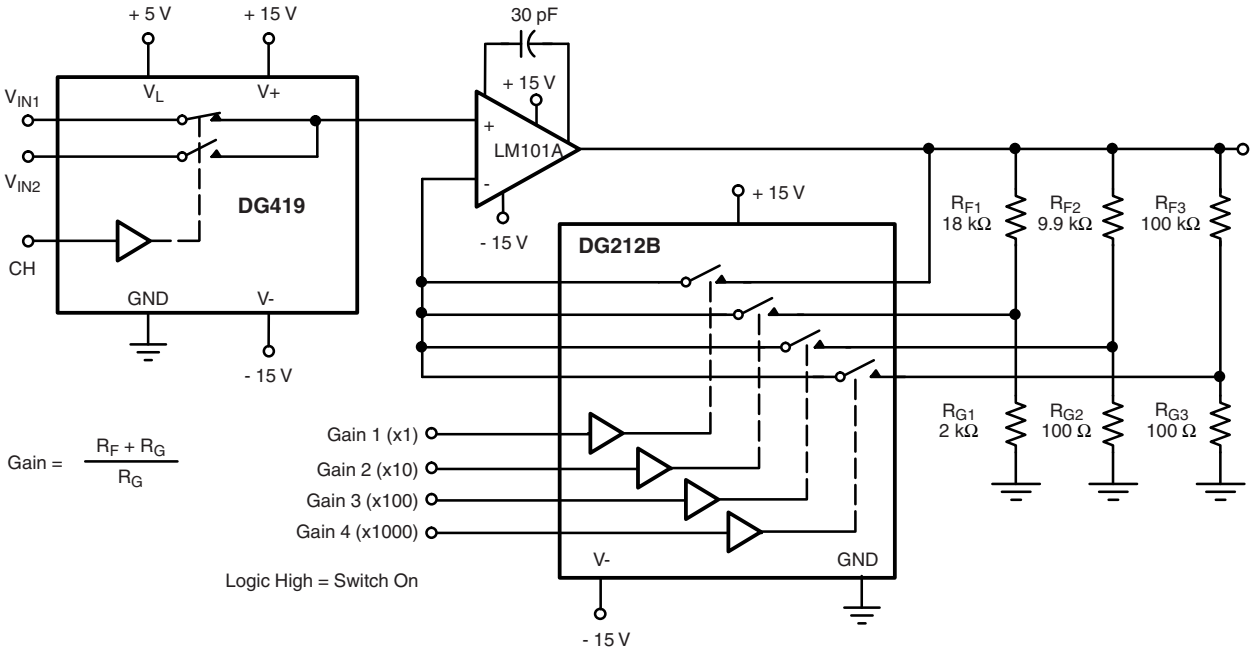


Fig. 8 - A Precision Amplifier with Digitally Programmable Input and Gains

PRODUCT SUMMARY						
Part number	DG211B	DG211B	DG211B	DG212B	DG212B	DG212B
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)	36	36	36	36	36	36
On-resistance (Ω)	22	22	22	22	22	22
Charge injection (pC)	45	45	45	45	45	45
Source on capacitance (pF)	1	1	1	1	1	1
Source off capacitance (pF)	-	-	-	-	-	-
Leakage switch on typ. (nA)	5	5	5	5	5	5
Leakage switch off max. (nA)	0.02	0.02	0.02	0.02	0.02	0.02
-3 dB bandwidth (MHz)	0.5	0.5	0.5	0.5	0.5	0.5
Package	TSSOP-16	SO-16 (narrow) AS	Plastic DIP-16	TSSOP-16	SO-16 (narrow) AS	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)	300	300	300	300	300	300
Crosstalk and off isolation	-90	-90	-90	-90	-90	-90

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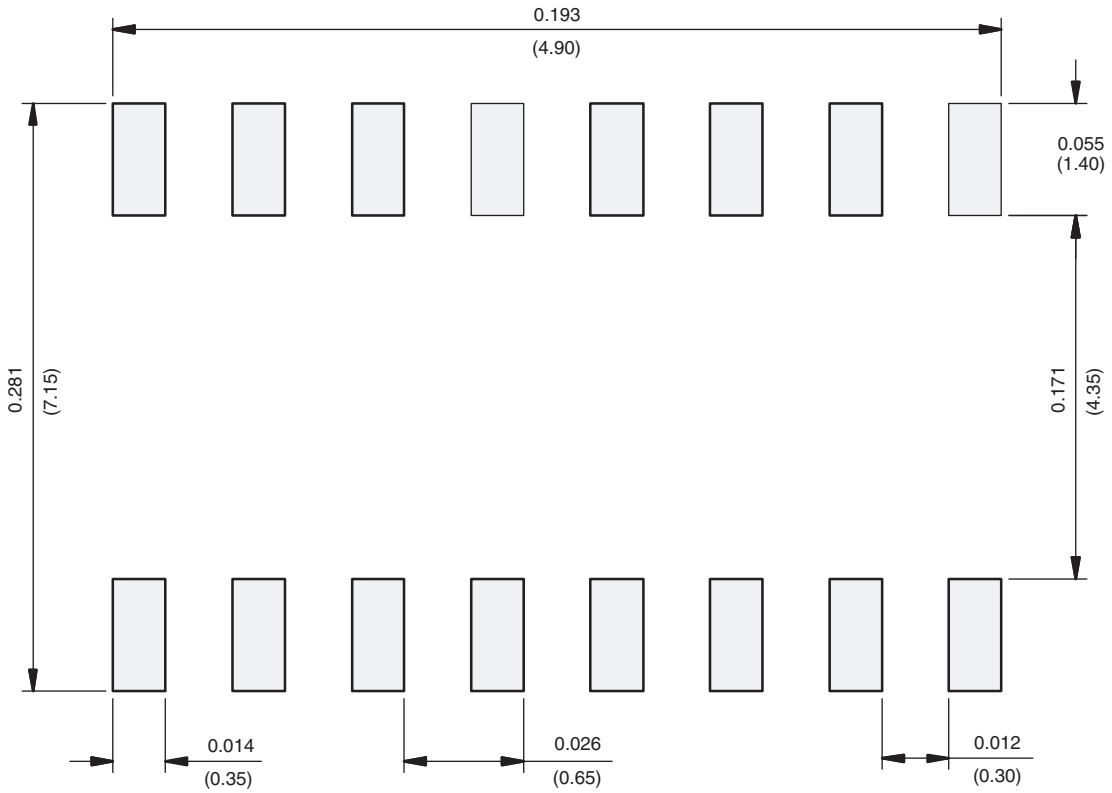
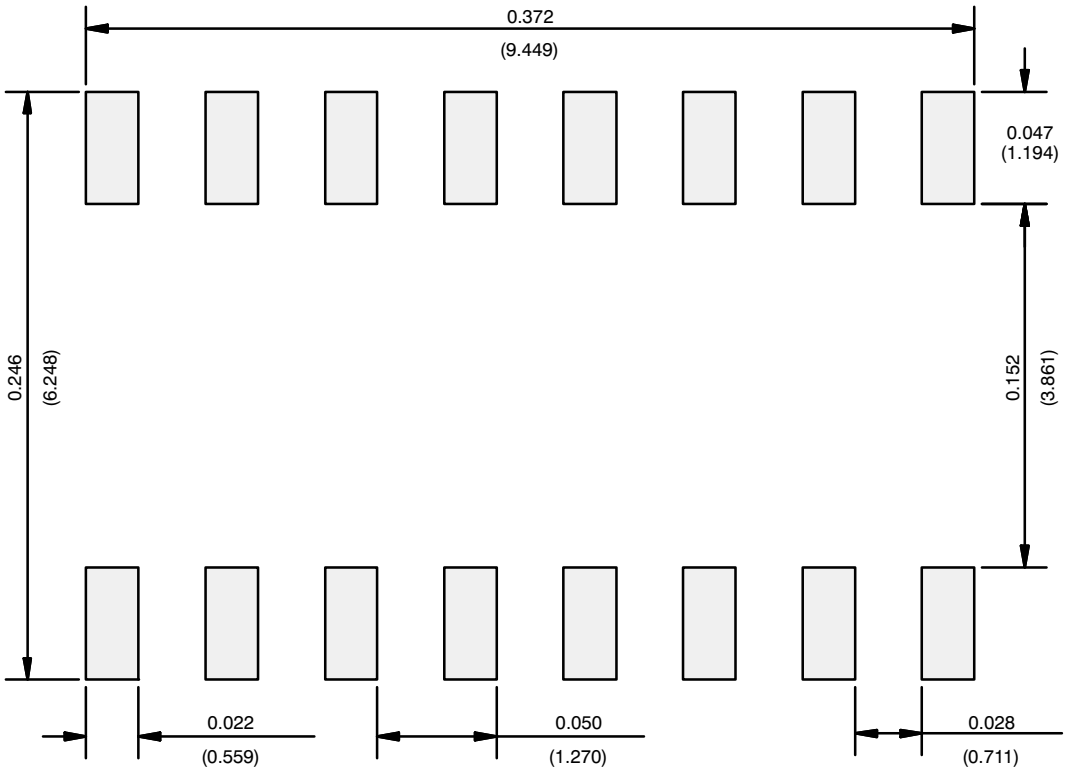
RECOMMENDED MINIMUM PAD FOR TSSOP-16



Recommended Minimum Pads
Dimensions in inches (mm)

RECOMMENDED MINIMUM PADS FOR SO-16



Recommended Minimum Pads
Dimensions in Inches/(mm)

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