

## 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  $\pm 22$  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.)

### FEATURES

- $\pm 22$  V supply voltage rating
- TTL and CMOS compatible logic
- Low on-resistance -  $R_{DS(on)}$ : 50  $\Omega$
- 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

### BENEFITS

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

### APPLICATIONS

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



RoHS\*  
COMPLIANT

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



TRUTH TABLE		
Logic	DG211B	DG212B
0	ON	OFF
1	OFF	ON

Logic "0"  $\leq 0.8$  V  
Logic "1"  $\geq 2.4$  V

\* Pb containing terminations are not RoHS compliant, exemptions may apply.

ORDERING INFORMATION			
Temp. Range	Package	Standard Part Number	Lead (Pb)-free Part Number
- 40 °C to 85 °C	16-Pin Plastic DIP	DG211BDJ	DG211BDJ-E3
		DG212BDJ	DG212BDJ-E3
	16-Pin Narrow SOIC	DG211BDY DG211BDY-T1	DG211BDY-E3 DG211BDY-T1-E3
		DG212BDY DG212BDY-T1	DG212BDY-E3 DG212BDY-T1-E3
	16-Pin TSSOP	DG211BDQ DG211BDQ-T1	DG211BDQ-E3 DG211BDQ-T1-E3
		DG212BDQ DG212BDQ-T1	DG212BDQ-E3 DG212BDQ-T1-E3

ABSOLUTE MAXIMUM RATINGS (T <sub>A</sub> = 25 °C, unless otherwise noted)			
Parameter		Limit	Unit
Voltages Referenced, V <sub>+</sub> to V <sub>-</sub>		44	V
GND		25	
Digital Inputs <sup>a</sup> , V <sub>S</sub> , V <sub>D</sub>		(V <sub>-</sub> - 2 to (V <sub>+</sub> ) + 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) <sup>b</sup>	16-Pin Plastic DIP <sup>c</sup>	470	mW
	16-Pin Narrow SOIC and TSSOP <sup>d</sup>	640	

Notes:

- a. Signals on S<sub>x</sub>, D<sub>x</sub>, or IN<sub>x</sub> exceeding V<sub>+</sub> or V<sub>-</sub> 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)



Figure 1.



SPECIFICATIONS							
Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_+ = 15\text{ V}$ , $V_- = -15\text{ V}$ $V_L = 5\text{ V}$ , $V_{IN} = 2.4\text{ V}$ , $0.8\text{ V}^e$	Temp. <sup>a</sup>	D Suffix - 40 °C to 85 °C			Unit
				Min. <sup>b</sup>	Typ. <sup>c</sup>	Max. <sup>b</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>d</sup>	$V_{ANALOG}$		Full	- 15		15	V
Drain-Source On-Resistance	$R_{DS(on)}$	$V_D = \pm 10\text{ V}$ , $I_S = 1\text{ mA}$	Room		45	85	$\Omega$
$R_{DS(on)}$ Match	$\Delta R_{DS(on)}$		Full		2	100	
Source Off Leakage Current	$I_{S(off)}$	$V_S = \pm 14\text{ V}$ , $V_D = \pm 14\text{ V}$	Room	- 0.5	$\pm 0.01$	0.5	nA
Drain Off Leakage Current	$I_{D(off)}$	$V_D = \pm 14\text{ V}$ , $V_S = \pm 14\text{ V}$	Full	- 5		5	
Drain On Leakage Current	$I_{D(on)}$	$V_S = V_D = \pm 14\text{ V}$	Room	- 0.5	$\pm 0.01$	0.5	
			Full	- 10	$\pm 0.02$	10	
<b>Digital Control</b>							
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	$\mu\text{A}$
Input Capacitance	$C_{IN}$		Room		5		pF
<b>Dynamic Characteristics</b>							
Turn-On Time	$t_{ON}$	$V_S = 10\text{ V}$ see figure 2	Room			300	ns
Turn-Off Time	$t_{OFF}$		Room			200	
Charge Injection	Q	$C_L = 1000\text{ pF}$ , $V_{gen} = 0\text{ V}$ , $R_{gen} = 0\ \Omega$	Room		1		pC
Source-Off Capacitance	$C_{S(off)}$	$V_S = 0\text{ V}$ , $f = 1\text{ MHz}$	Room		5		pF
Drain-Off Capacitance	$C_{D(off)}$		Room		5		
Channel-On Capacitance	$C_{D(on)}$	$V_D = V_S = 0\text{ V}$ , $f = 1\text{ MHz}$	Room		16		dB
Off Isolation	OIRR	$C_L = 15\text{ pF}$ , $R_L = 50\ \Omega$ , $V_S = 1\text{ V}_{RMS}$ , $f = 100\text{ kHz}$	Room		90		
Channel-to-Channel Crosstalk	$X_{TALK}$		Room		95		
<b>Power Supply</b>							
Positive Supply Current	$I_+$	$V_{IN} = 0$ or $5\text{ V}$	Room			10	$\mu\text{A}$
Negative Supply Current	$I_-$		Full	- 10		50	
Logic Supply Current	$I_L$		Full	- 50			
Power Supply Range for Continuous Operation	$V_{OP}$		Room			10	V
			Full	$\pm 4.5$		50	
			Full			$\pm 22$	

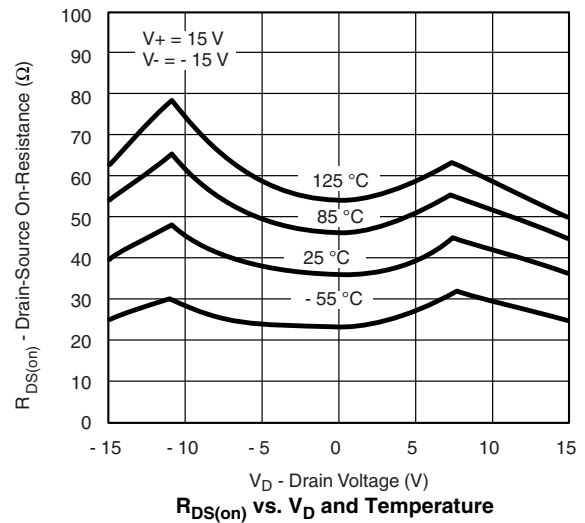
SPECIFICATIONS (for Single Supply)							
Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_+ = 12\text{ V}$ , $V_- = 0\text{ V}$ $V_L = 5\text{ V}$ , $V_{IN} = 2.4\text{ V}$ , $0.8\text{ V}^e$	Temp. <sup>a</sup>	D Suffix -40 °C to 85 °C			Unit
				Min. <sup>b</sup>	Typ. <sup>c</sup>	Max. <sup>b</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>d</sup>	$V_{ANALOG}$		Full	0		12	V
Drain-Source On-Resistance	$R_{DS(on)}$	$V_D = 3\text{ V}$ , $8\text{ V}$ , $I_S = 1\text{ mA}$	Room Full		90	160 200	$\Omega$
<b>Dynamic Characteristics</b>							
Turn-On Time	$t_{ON}$	$V_S = 8\text{ V}$ see figure 1	Room			300	ns
Turn-Off Time	$t_{OFF}$		Room			200	
Charge Injection	Q	$C_L = 1\text{ nF}$ , $V_{gen} = 6\text{ V}$ , $R_{gen} = 0\ \Omega$	Room		4		pC
<b>Power Supply</b>							
Positive Supply Current	$I_+$	$V_{IN} = 0\text{ or }5\text{ V}$	Room Full			10 50	$\mu\text{A}$
Negative Supply Current	$I_-$		Room Full	-10 -50			
Logic Supply Current	$I_L$		Room Full			10 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 data sheet.
- 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 (T<sub>A</sub> = 25 °C, unless otherwise noted)



**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



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



**Leakage Currents vs. Analog Voltage**



**Leakage Current vs. Temperature**



**$Q_S, Q_D$  - Charge Injection vs. Analog Voltage**



**Off Isolation vs. Frequency**

## TEST CIRCUITS



Figure 2. Switching Time



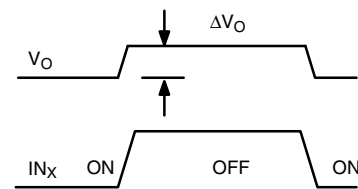
Figure 3. Off Isolation



Figure 4. Channel-to-Channel Crosstalk



Figure 5. Charge Injection



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

## APPLICATIONS

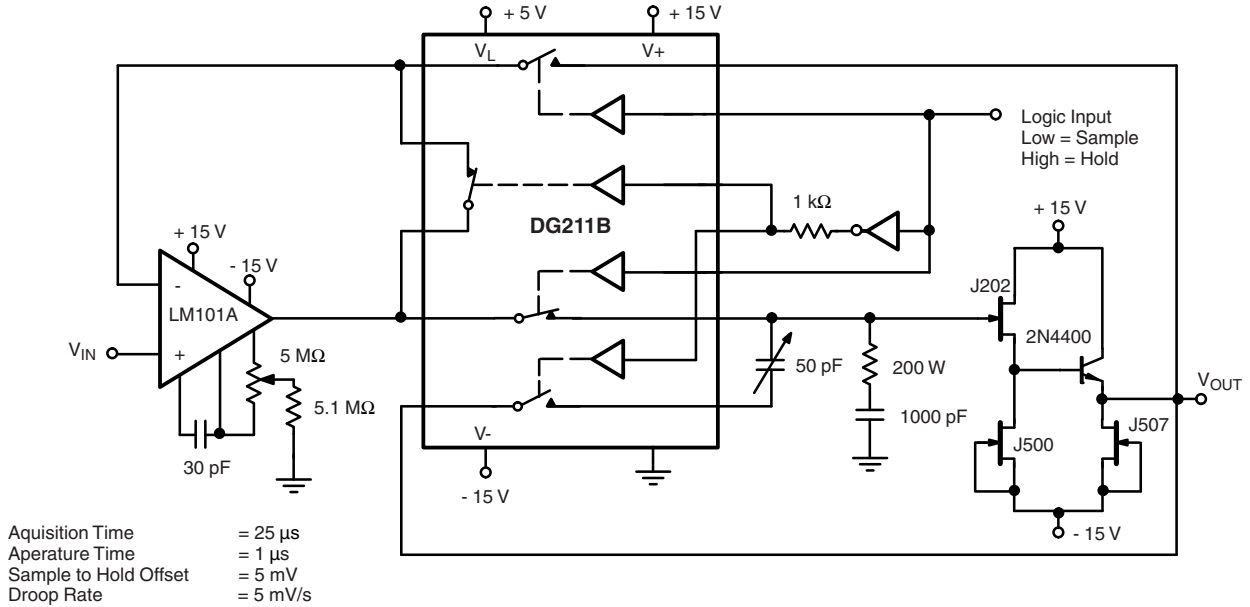
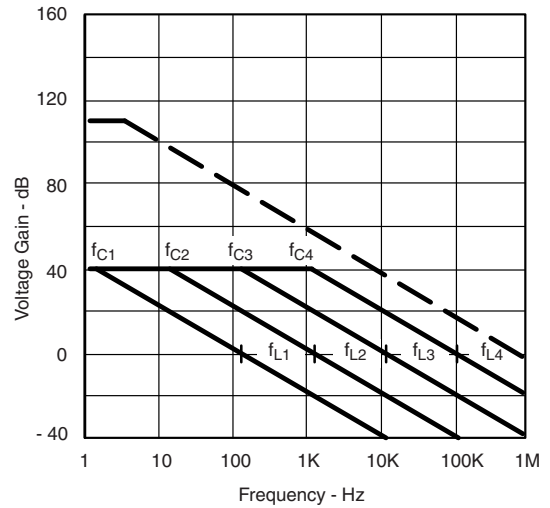


Figure 6. Sample-and-Hold



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



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

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

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

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

## APPLICATIONS



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

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**SOIC (NARROW): 16-LEAD**  
JEDEC Part Number: MS-012



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	1.35	1.75	0.053	0.069
A <sub>1</sub>	0.10	0.20	0.004	0.008
B	0.38	0.51	0.015	0.020
C	0.18	0.23	0.007	0.009
D	9.80	10.00	0.385	0.393
E	3.80	4.00	0.149	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
L	0.50	0.93	0.020	0.037
∅	0°	8°	0°	8°

ECN: S-03946—Rev. F, 09-Jul-01  
DWG: 5300



### PDIP: 16-LEAD



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
<b>A</b>	3.81	5.08	0.150	0.200
<b>A<sub>1</sub></b>	0.38	1.27	0.015	0.050
<b>B</b>	0.38	0.51	0.015	0.020
<b>B<sub>1</sub></b>	0.89	1.65	0.035	0.065
<b>C</b>	0.20	0.30	0.008	0.012
<b>D</b>	18.93	21.33	0.745	0.840
<b>E</b>	7.62	8.26	0.300	0.325
<b>E<sub>1</sub></b>	5.59	7.11	0.220	0.280
<b>e<sub>1</sub></b>	2.29	2.79	0.090	0.110
<b>e<sub>A</sub></b>	7.37	7.87	0.290	0.310
<b>L</b>	2.79	3.81	0.110	0.150
<b>Q<sub>1</sub></b>	1.27	2.03	0.050	0.080
<b>S</b>	0.38	1.52	.015	0.060

ECN: S-03946—Rev. D, 09-Jul-01  
DWG: 5482

## TSSOP: 16-LEAD



Symbols	DIMENSIONS IN MILLIMETERS		
	Min	Nom	Max
A	-	1.10	1.20
A1	0.05	0.10	0.15
A2	-	1.00	1.05
B	0.22	0.28	0.38
C	-	0.127	-
D	4.90	5.00	5.10
E	6.10	6.40	6.70
E1	4.30	4.40	4.50
e	-	0.65	-
L	0.50	0.60	0.70
L1	0.90	1.00	1.10
y	-	-	0.10
θ1	0°	3°	6°

ECN: S-61920-Rev. D, 23-Oct-06  
DWG: 5624



**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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