

## Quad Complementary CMOS Analog Switch

### Features

- $\pm 22$ -V Supply Voltage Rating
- TTL and CMOS Compatible Logic
- Low On-Resistance— $r_{DS(on)}$ :  $45 \Omega$
- Low Leakage— $I_{D(on)}$ :  $20 \text{ pA}$
- Single Supply Operation Possible
- Extended Temperature Range
- Fast Switching— $t_{ON}$ :  $85 \text{ ns}$

### Benefits

- Low Charge Injection— $Q$ :  $1 \text{ pC}$
- Wide Analog Signal Range
- Simple Logic Interface
- Higher Accuracy
- Minimum Transients
- Reduced Power Consumption
- Low Cost

### Applications

- Industrial Instrumentation
- Test Equipment
- Communications Systems
- Computer Peripherals
- Portable Instruments
- Sample-and-Hold Circuits

## Description

The versatile DG213 analog switch has two NC and two NO switches. It can be used in various configurations, including four single-pole single-throw (SPST), two single-pole double-throw (SPDT), one "T" switch, one DPDT, etc. This device is fabricated in a Siliconix' proprietary high-voltage silicon gate CMOS process, resulting in lower on-resistance, lower leakage, higher speed, and lower power consumption.

This analog switch was designed for a wide variety of general purpose applications in telecommunications, instrumentation, process control, computer peripherals, etc.

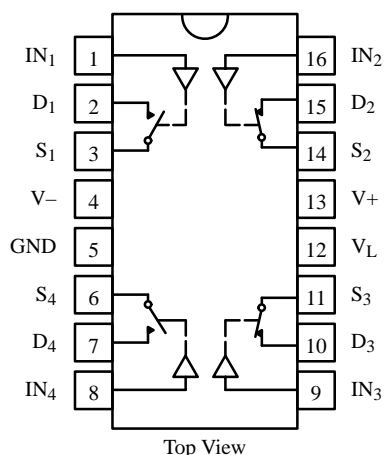
An improved charge injection compensation design minimizes switching transients. These switches can handle up to  $\pm 22 \text{ V}$ , and have an improved continuous current rating of  $30 \text{ mA}$ . An epitaxial layer prevents latchup.

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

For additional information, please refer to Application Note AN208.

## Functional Block Diagram and Pin Configuration

### DG213



### Truth Table

Logic	SW <sub>1</sub> , SW <sub>4</sub>	SW <sub>2</sub> , SW <sub>3</sub>
0	OFF	ON
1	ON	OFF

Logic "0"  $\leq 0.8 \text{ V}$

Logic "1"  $\geq 2.4 \text{ V}$

### Ordering Information

Temp Range	Package	Part Number
-40 to 85°C	16-Pin Plastic DIP	DG213DJ
	16-Pin Narrow SOIC	DG213DY
	16-Pin TSSOP	DG213DQ

Updates to this data sheet may be obtained via facsimile by calling Siliconix FaxBack, 1-408-970-5600. Please request FaxBack document #70662. Applications information may also be obtained via FaxBack, request document #70606.

# DG213

## Absolute Maximum Ratings

Voltages Referenced to V–

V+	44 V
GND	25 V
Digital Inputs <sup>a</sup> V <sub>S</sub> , V <sub>D</sub>	(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	–65 to 125°C

Power Dissipation (Package)<sup>b</sup>

16-Pin Plastic DIP <sup>c</sup>	470 mW
16-Pin Narrow SOIC <sup>d</sup>	640 mW
16-Pin TSSOP <sup>d</sup>	500 mW

Notes:

- Signals on S<sub>X</sub>, D<sub>X</sub>, or IN<sub>X</sub> exceeding V+ or V– will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- All leads welded or soldered to PC Board.
- Derate 6.5 mW/°C above 75°C
- Derate 7.6 mW/°C above 75°C

## Specifications

Parameter	Symbol	Test Conditions Unless Otherwise Specified V+ = 15 V, V– = –15 V V <sub>L</sub> = 5 V, V <sub>IN</sub> = 2.4 V, 0.8 V <sup>e</sup>	Temp <sup>a</sup>	D Suffix –40 to 85°C			Unit
				Min <sup>c</sup>	Typ <sup>b</sup>	Max <sup>c</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>d</sup>	V <sub>ANALOG</sub>		Full	V–		V+	V
Drain-Source On-Resistance	r <sub>DS(on)</sub>	V <sub>D</sub> = ±10 V, I <sub>S</sub> = 1 mA	Room		45	60	Ω
r <sub>DS(on)</sub> Match	Δr <sub>DS(on)</sub>		Full			85	
Source Off Leakage Current	I <sub>S(off)</sub>	V <sub>S</sub> = ±14 V, V <sub>D</sub> = ∓14 V	Room	–0.5	±0.01	0.5	nA
Drain Off Leakage Current	I <sub>D(off)</sub>	V <sub>D</sub> = ±14 V, V <sub>S</sub> = ∓14 V	Full	–5		5	
Drain On Leakage Current	I <sub>D(on)</sub>	V <sub>S</sub> = V <sub>D</sub> = 14 V	Room	–0.5	±0.02	0.5	
			Full	–10		10	
<b>Digital Control</b>							
Input Voltage High	V <sub>INH</sub>		Full	2.4			V
Input Voltage Low	V <sub>INL</sub>		Full			0.8	
Input Current	I <sub>INH</sub> or I <sub>INL</sub>	V <sub>INH</sub> or V <sub>INL</sub>	Full	–1		1	μA
Input Capacitance	C <sub>IN</sub>		Room		5		pF
<b>Dynamic Characteristics</b>							
Turn-On Time	t <sub>ON</sub>	V <sub>S</sub> = 2 V See Figure 2	Room		85	130	ns
Turn-Off Time	t <sub>OFF</sub>		Room		55	100	
Break-Before-Make Time Delay	t <sub>D</sub>	V <sub>S</sub> = 10 V, See Figure 3	Room	20	25		
Charge Injection	Q	C <sub>L</sub> = 1000 pF, V <sub>g</sub> = 0 V, R <sub>g</sub> = 0 Ω	Room		1		pC
Source-Off Capacitance	C <sub>S(off)</sub>	V <sub>S</sub> = 0 V, f = 1 MHz	Room		5		pF
Drain-Off Capacitance	C <sub>D(off)</sub>		Room		5		
Channel On Capacitance	C <sub>D(on)</sub>	V <sub>D</sub> = V <sub>S</sub> = 0 V, f = 1 MHz	Room		16		
Off Isolation	OIRR	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 50 Ω V <sub>S</sub> = 1 V <sub>RMS</sub> , f = 100 kHz	Room		90		dB
Channel-to-Channel Crosstalk	X <sub>TALK</sub>		Room		95		

## 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 to 85°C			Unit
				Min <sup>c</sup>	Typ <sup>b</sup>	Max <sup>c</sup>	
<b>Power Supply</b>							
Positive Supply Current	I+	$V_{IN} = 0\text{ or }5\text{ V}$	Room Full			1 5	μA
Negative Supply Current	I-		Room Full	-1 -5			
Logic Supply Current	I <sub>L</sub>		Room Full			1 5	
Power Supply Range for Continuous Operation	V <sub>OP</sub>		Full	±3		±22	V

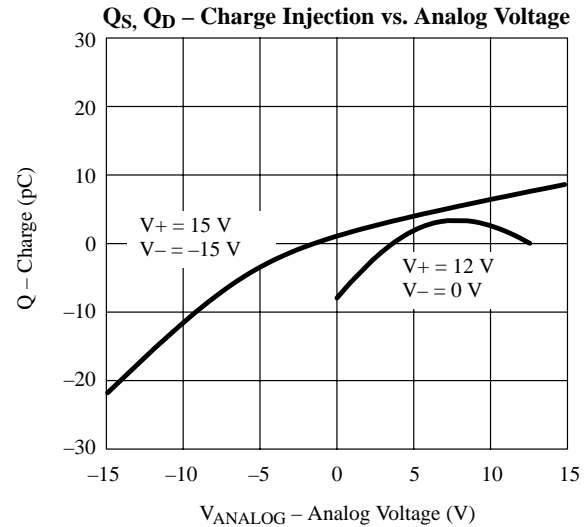
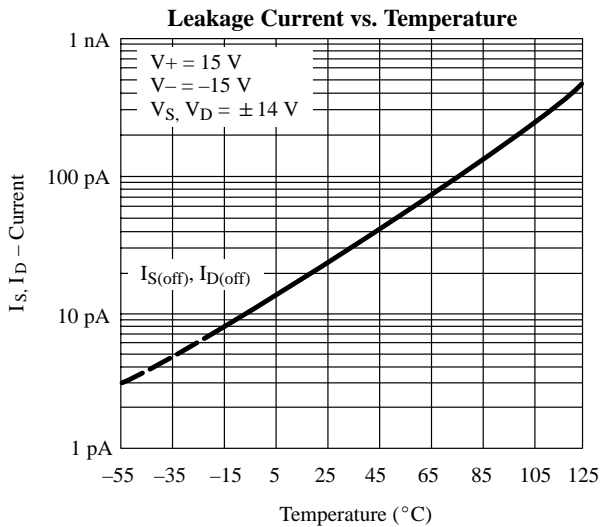
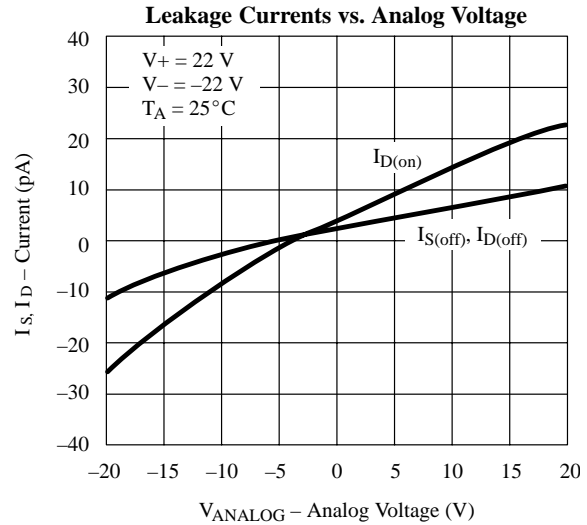
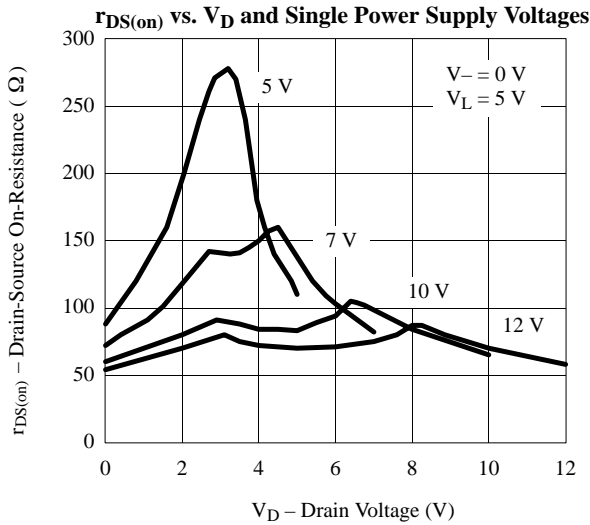
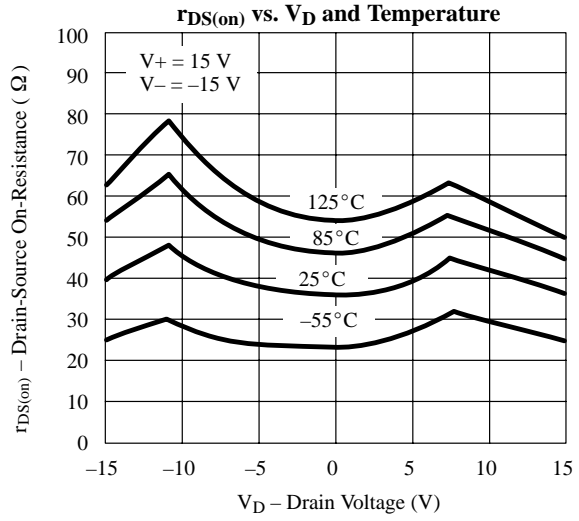
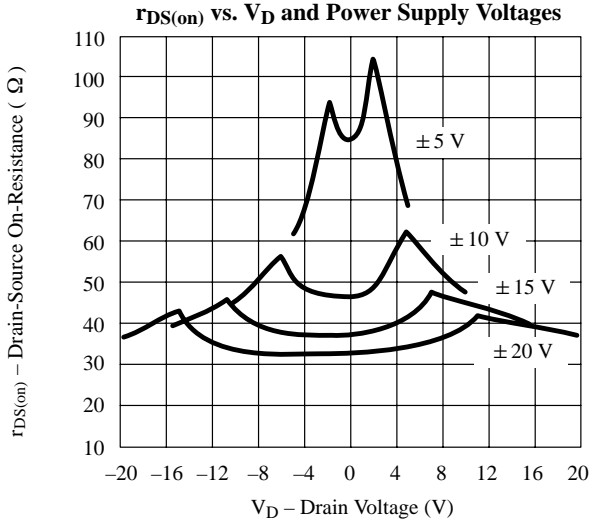
## Specifications for Unipolar Supply

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 to 85°C			Unit
				Min <sup>c</sup>	Typ <sup>b</sup>	Max <sup>c</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>d</sup>	V <sub>ANALOG</sub>		Full	V-		V+	V
Drain-Source On-Resistance	r <sub>DS(on)</sub>	$V_D = 3\text{ V}$ , $8\text{ V}$ , $I_S = 1\text{ mA}$	Room Full		90	110 140	Ω
<b>Dynamic Characteristics</b>							
Turn-On Time	t <sub>ON</sub>	$V_S = 8\text{ V}$ See Figure 2	Room		125	200	ns
Turn-Off Time	t <sub>OFF</sub>		Room		45	100	
Break-Before-Make Time Delay	t <sub>D</sub>	DG213 Only, See Figure 3	Room	50	80		
Charge Injection	Q	$C_L = 1\text{ nF}$ , $V_{gen} = 6\text{ V}$ , $R_{gen} = 0\text{ Ω}$	Room		4		pC
<b>Power Supply</b>							
Positive Supply Current	I+	$V_{IN} = 0\text{ or }5\text{ V}$	Room Full			1 5	μA
Negative Supply Current	I-		Room Full	-1 -5			
Logic Supply Current	I <sub>L</sub>		Room Full			1 5	
Power Supply Range for Continuous Operation	V <sub>OP</sub>		Full	+3		+40	V

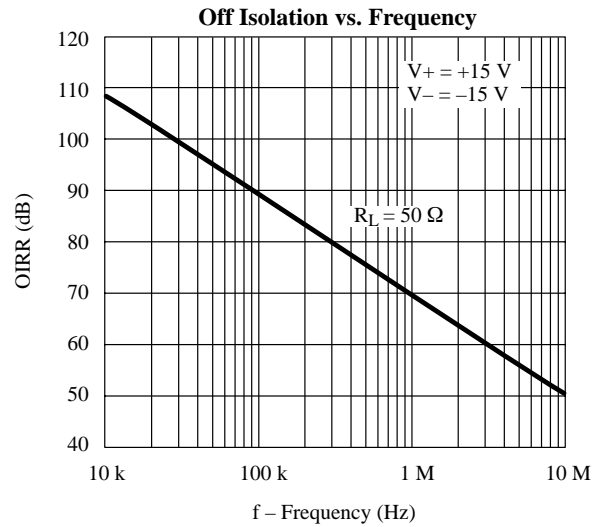
### Notes:

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

## Typical Characteristics



## Typical Characteristics (Cont'd)



## Schematic Diagram (Typical Channel)

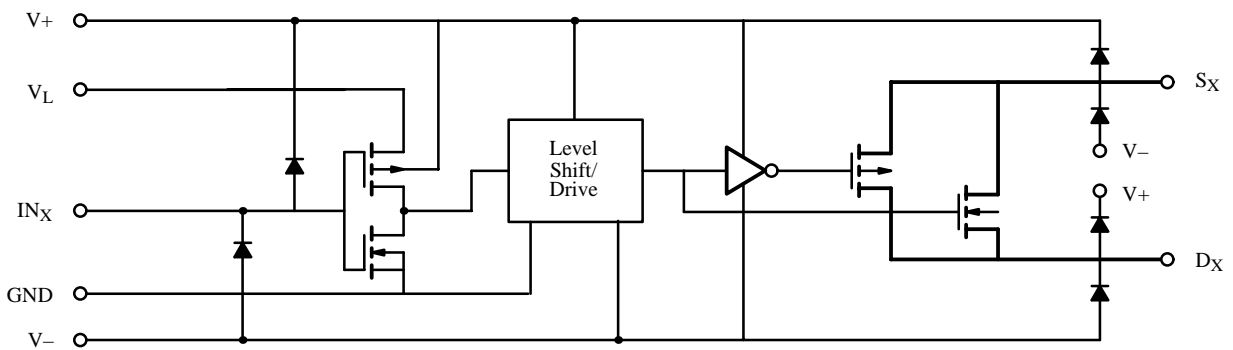


Figure 1.

## Test Circuits

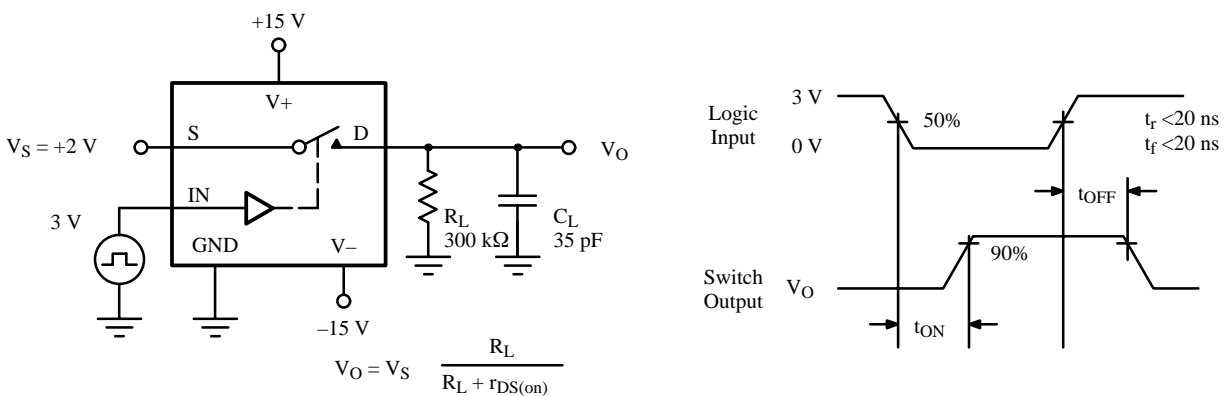
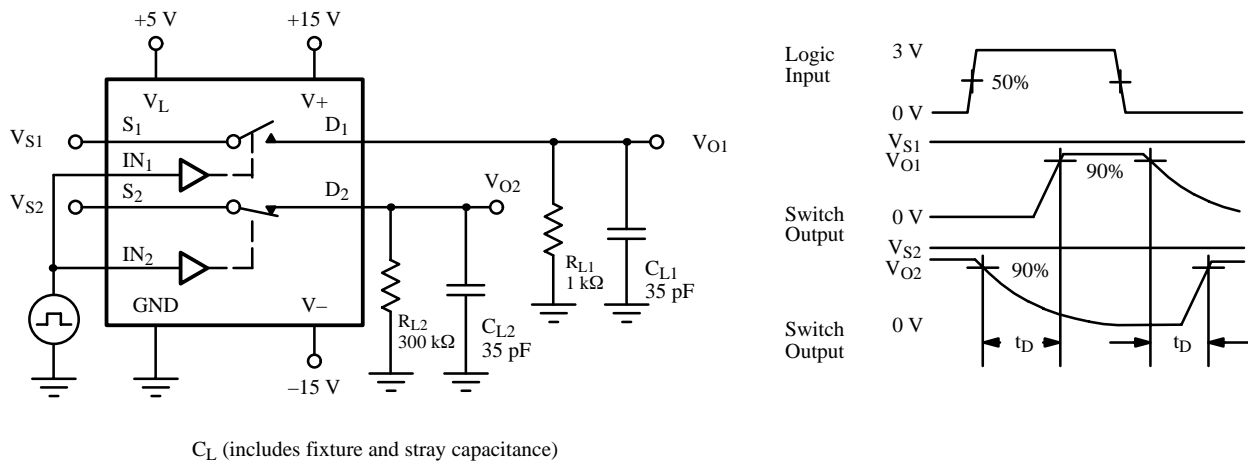
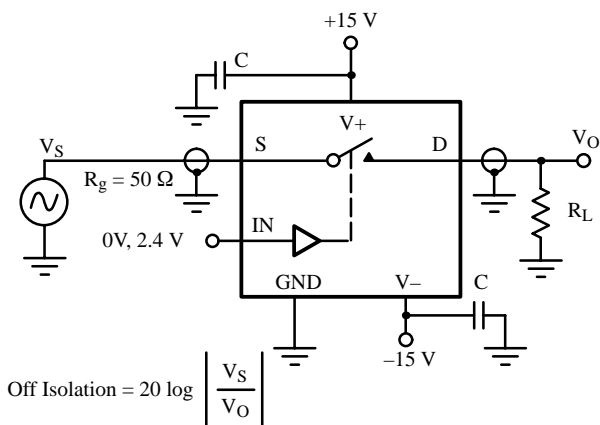


Figure 2. Switching Time

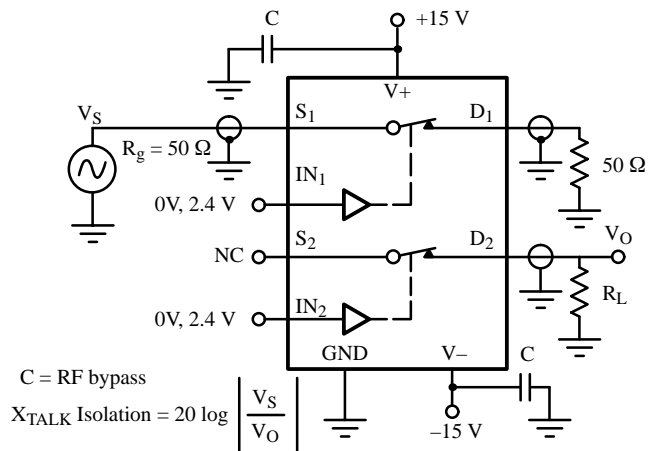
## Test Circuits (Cont'd)



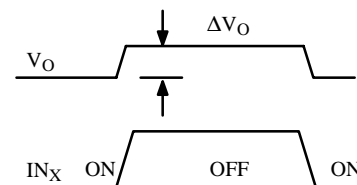
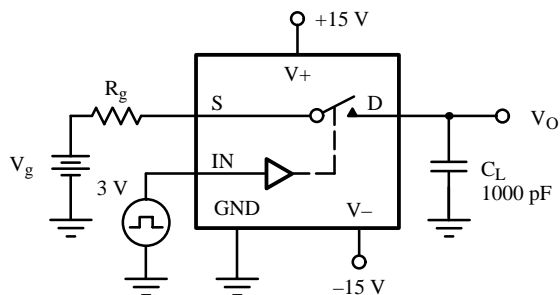
**Figure 3.** Break-Before-Make



**Figure 4.** Off Isolation



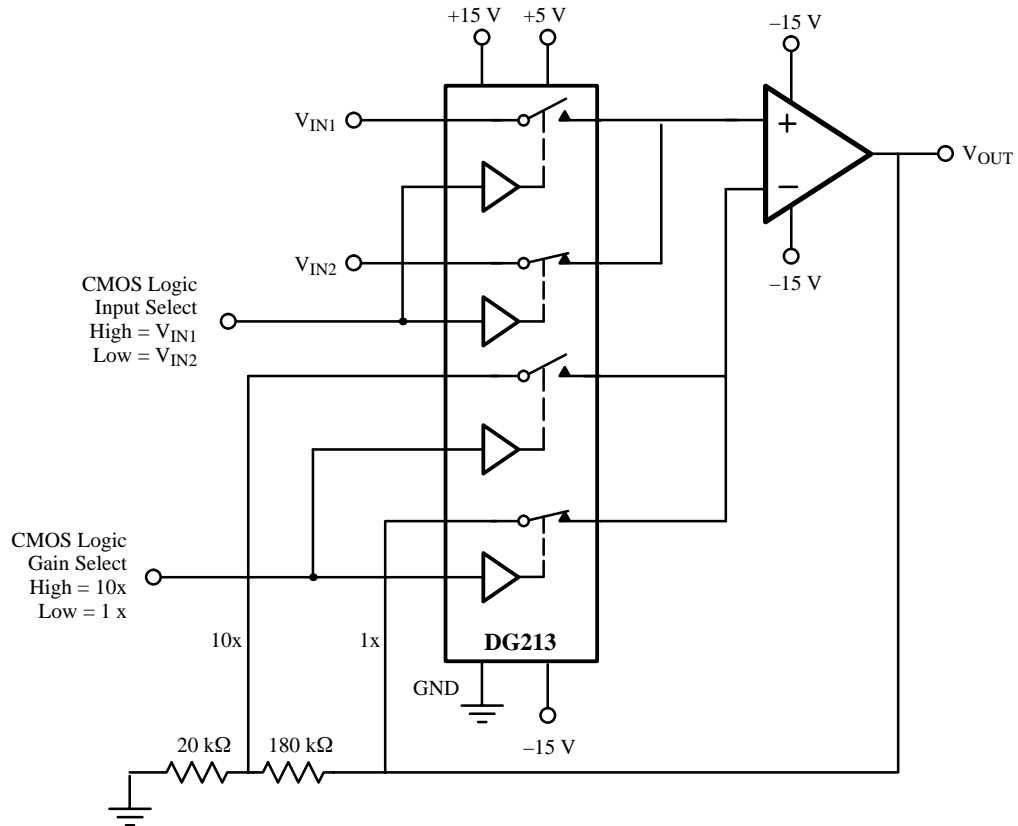
**Figure 5.** Channel-to-Channel Crosstalk



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

**Figure 6.** Charge Injection

## Applications



**Figure 7.** Low Power Non-Inverting Amplifier with Digitally Selectable Inputs and Gain