Quad Complementary CMOS Analog Switch

FEATURES

- ±22-V Supply Voltage Rating
- TTL and 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}: 85 ns

BENEFITS

- Low Charge Injection—Q: 1 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

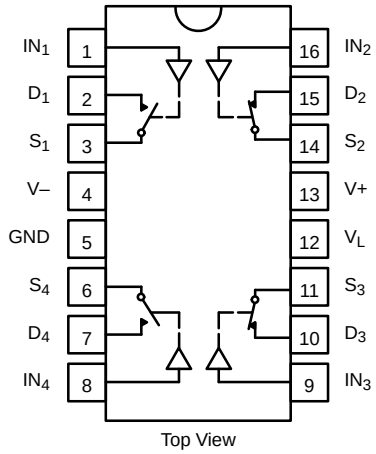
The versatile DG213 analog switch has two NC and two NO switches. It can be used in various configurations, including four single-pole single-throw (SPST), two single-pole double-throw (SPDT), one “T” switch, one DPDT, etc. This device is fabricated in a Vishay Siliconix’ proprietary high-voltage silicon 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 ±22 V, and have an improved continuous current rating of 30 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 (FaxBack document #70606).

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Top View

TRUTH TABLE

Logic	SW_1, SW_4	SW_2, SW_3
0	OFF	ON
1	ON	OFF

Logic “0” ≤ 0.8 V
Logic “1” ≥ 2.4 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

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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 . . . . . –65 to 125°C

Power Dissipation (Package)b
16-Pin Plastic DIP[c] . . . . . 470 mW
16-Pin Narrow SOIC[d] . . . . . 640 mW
16-Pin TSSOP[d] . . . . . 500 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

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 to 85°C Min[c]	Typ[b]	Max[c]	Unit
Analog Switch							
Analog Signal Range[d]	V_{ANALOG}		Full	V–		V+	V
Drain-Source On-Resistance	$r_{DS(on)}$	V_D = ±10 V, I_S = 1 mA	Room Full		45	60 85	Ω
$r_{DS(on)}$ Match	$\Delta r_{DS(on)}$		Room		1	2	
Source Off Leakage Current	$I_{S(off)}$	V_S = ±14 V, V_D = ∓14 V	Room Full	–0.5 –5	±0.01	0.5 5	nA
Drain Off Leakage Current	$I_{D(off)}$	V_D = ±14 V, V_S = ∓14 V	Room Full	–0.5 –5	±0.01	0.5 5	
Drain On Leakage Current	$I_{D(on)}$	V_S = V_D = 14 V	Room Full	–0.5 –10	±0.02	0.5 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 Figure 2	Room		85	130	ns
Turn-Off Time	t_{OFF}		Room		55	100	
Break-Before-Make Time Delay	t_D	V_S = 10 V, See Figure 3	Room	15	25		
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	$C_{D(off)}$		Room		5		
Channel On Capacitance	$C_{D(on)}$	V_D = V_S = 0 V, f = 1 MHz	Room		16		
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}		Room		95		

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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 to 85°C Min[c]	Typ[b]	Max[c]	Unit
Power Supply							
Positive Supply Current	I+	V_{IN} = 0 or 5 V	Room Full			1 5	µA
Negative Supply Current	I–		Room Full	–1 –5			
Logic Supply Current	I_L		Room Full			1 5	
Power Supply Range for Continuous Operation	V_{OP}		Full	±3		±22	V

SPECIFICATIONS FOR UNIPOLAR 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 to 85°C Min[c]	Typ[b]	Max[c]	Unit
Analog Switch							
Analog Signal Range[d]	V_{ANALOG}		Full	V–		V+	V
Drain-Source On-Resistance	$r_{DS(on)}$	V_D = 3 V, 8 V, I_S = 1 mA	Room Full		90	110 140	Ω
Dynamic Characteristics							
Turn-On Time	t_{ON}	See Figure 2	Room		125	200	ns
Turn-Off Time	t_{OFF}		Room		45	100	
Break-Before-Make Time Delay	t_D	V_S = 8 V, See Figure 3	Room	50	80		
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 5 V	Room Full			1 5	µA
Negative Supply Current	I–		Room Full	–1 –5			
Logic Supply Current	I_L		Room Full			1 5	
Power Supply Range for Continuous Operation	V_{OP}		Full	+3		+40	V

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

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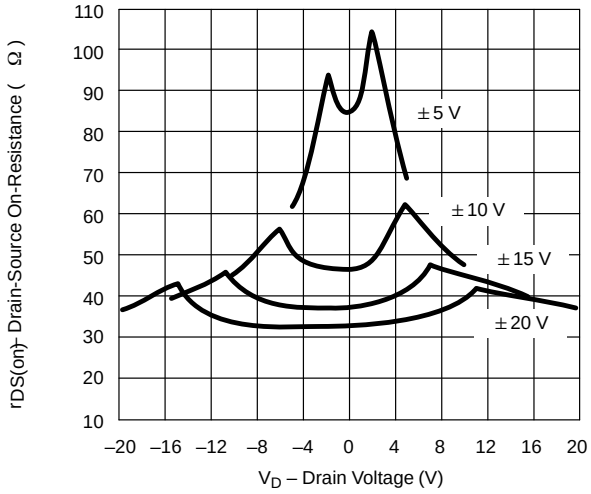
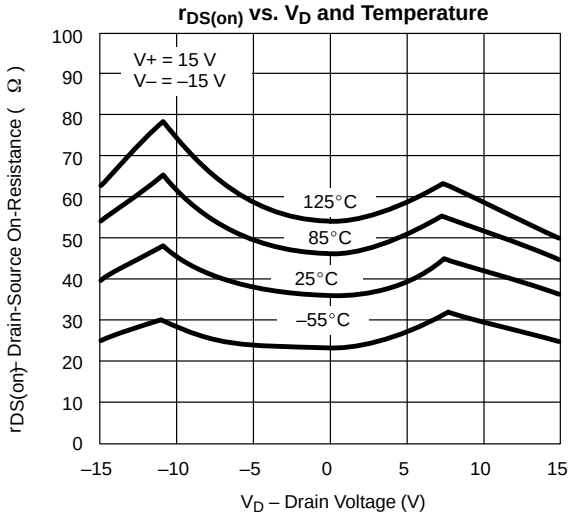
TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

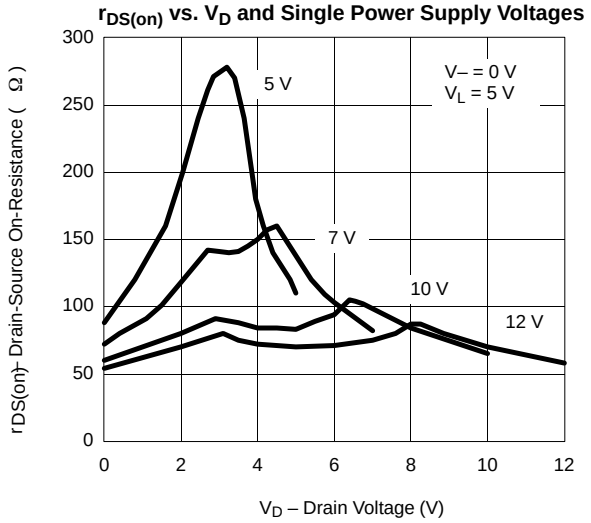
$r_{DS(on)}$ vs. V_D and Power Supply Voltages



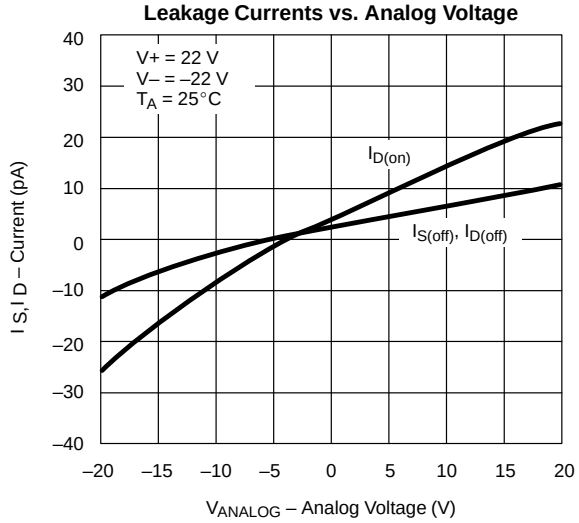
$r_{DS(on)}$ vs. V_D and Temperature



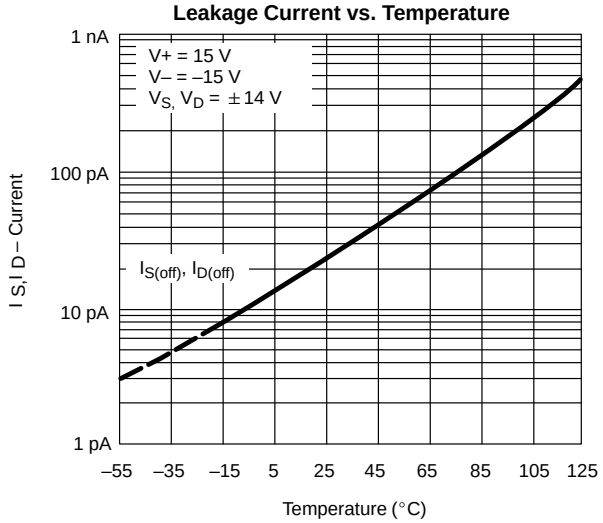
$r_{DS(on)}$ vs. V_D and Single Power Supply Voltages



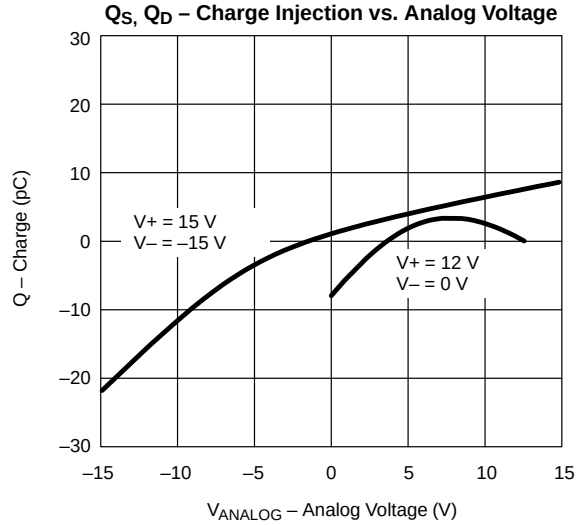
Leakage Currents vs. Analog Voltage



Leakage Current vs. Temperature



Q_S, Q_D – Charge Injection vs. Analog Voltage



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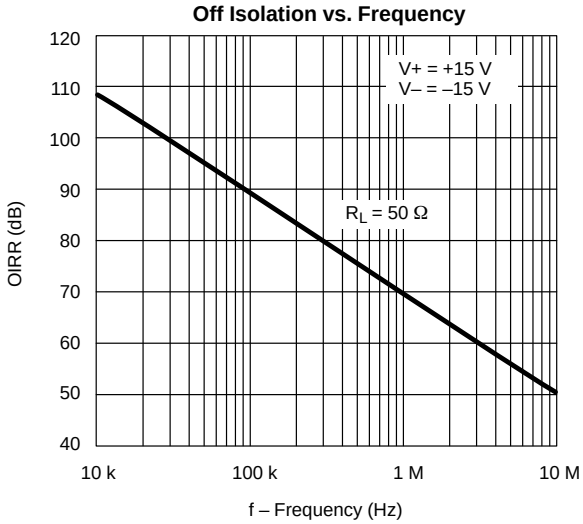
TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)



SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

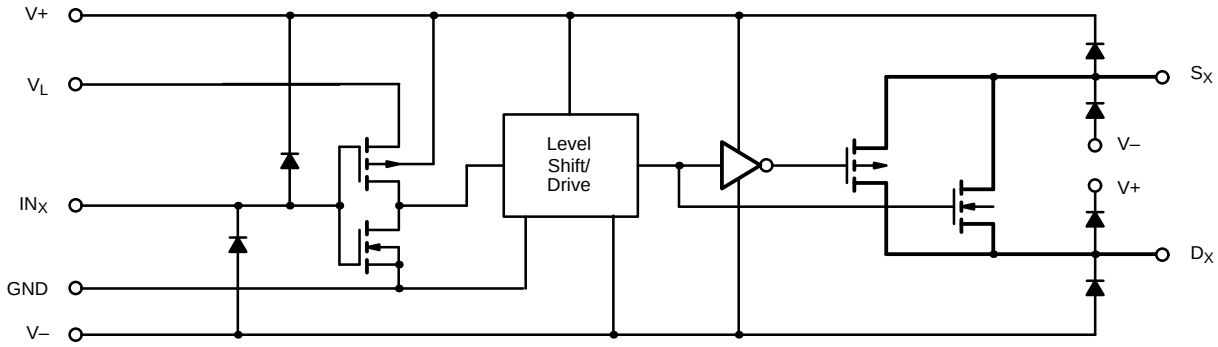
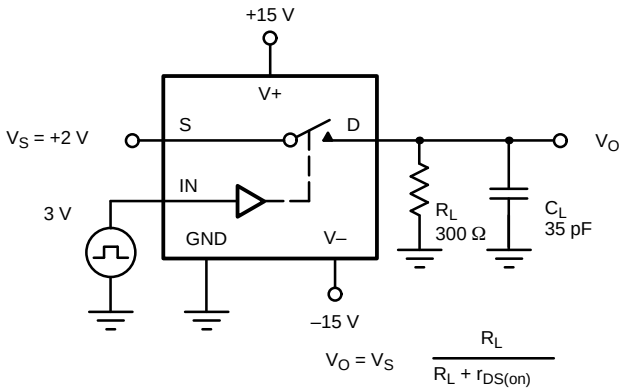


FIGURE 1.

TEST CIRCUITS



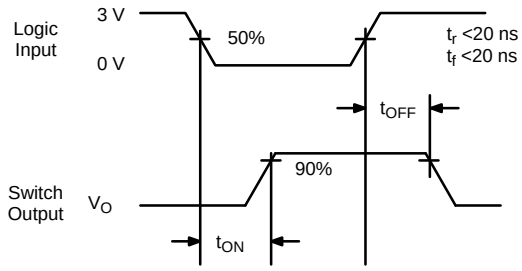


FIGURE 2. Switching Time

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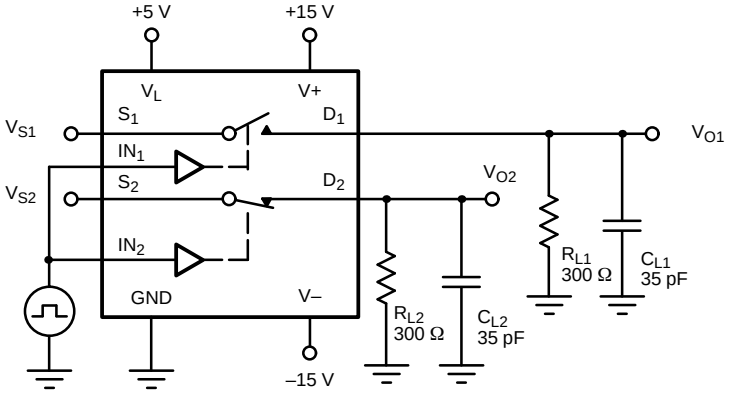
TEST CIRCUITS



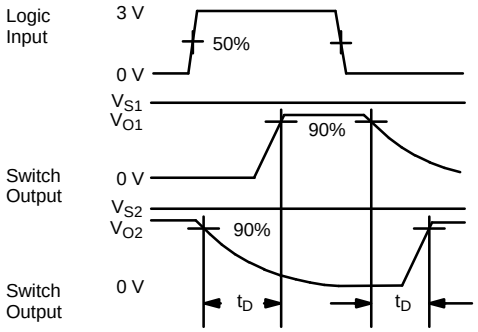


FIGURE 3. Break-Before-Make

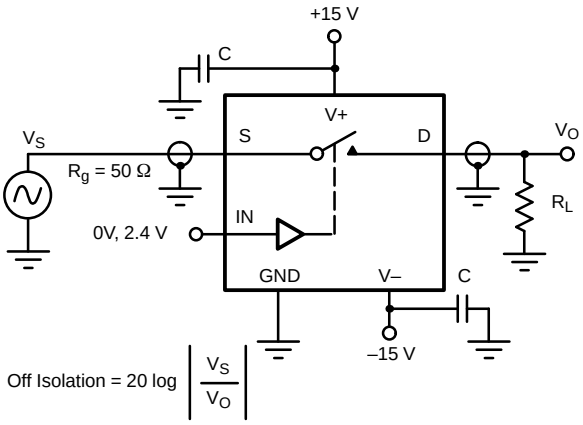


FIGURE 4. Off Isolation

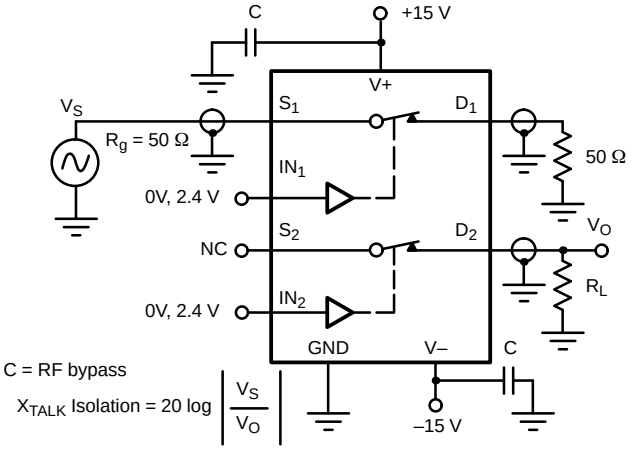
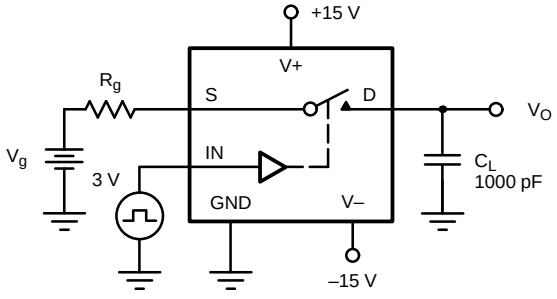
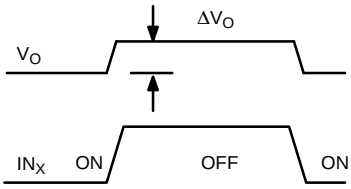


FIGURE 5. Channel-to-Channel Crosstalk





ΔV_O = measured voltage error due to charge injection
The charge injection in coulombs is Q = C_L x ΔV_O

FIGURE 6. Charge Injection

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APPLICATIONS

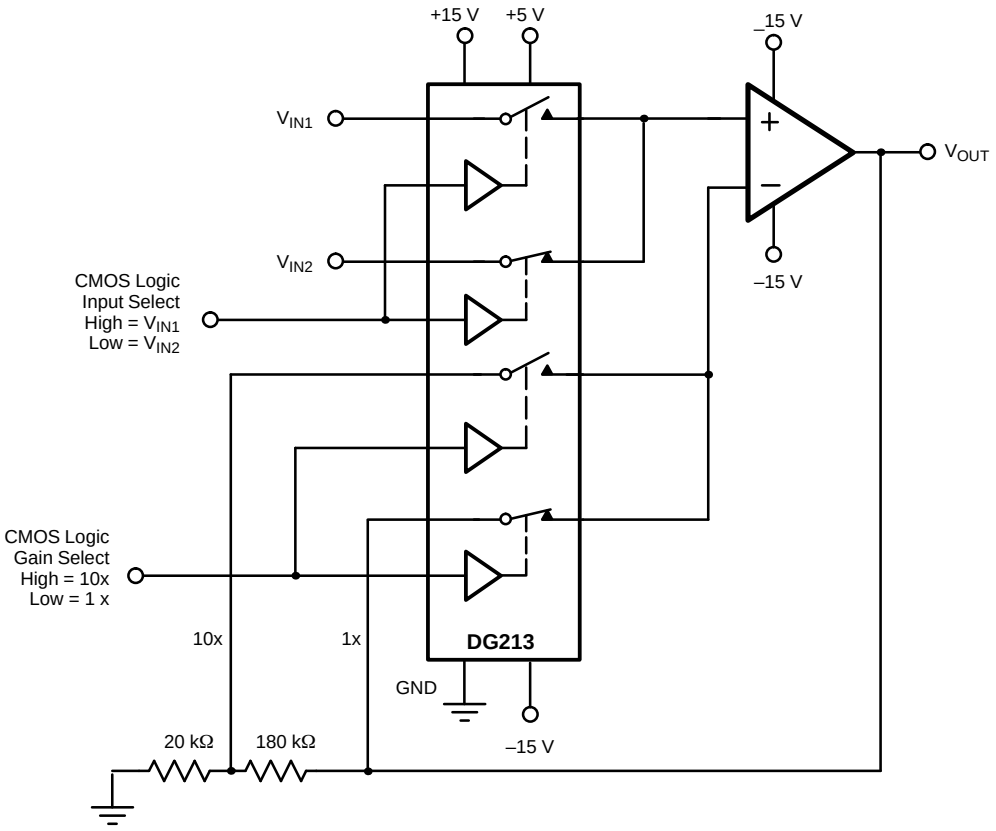

FIGURE 7. Low Power Non-Inverting Amplifier with Digitally Selectable Inputs and Gain

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