Quad Complementary CMOS Analog Switch

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 (www.vishay.com/doc?70606).

BENEFITS

- Wide analog signal range
- Simple logic interface
- Higher accuracy
- Minimum transients
- Reduced power consumption
- Low cost

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
- Low charge injection - Q: 1 pC
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

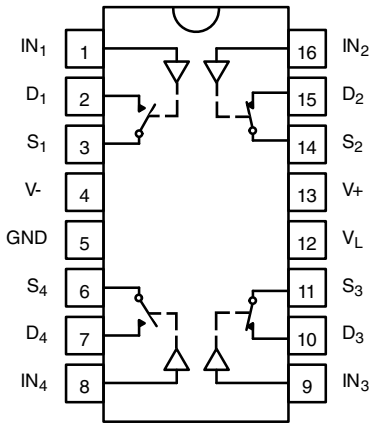
RoHS COMPLIANT

APPLICATIONS

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

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG213
Dual-In-Line. SOIC and TSSOP



Top View

TRUTH TABLE		
LOGIC	SW1, SW4	SW2, SW3
0	Off	On
1	On	Off

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	DG213DY-E3 DG213DY-T1-E3
	16-pin TSSOP	DG213DQ-E3 DG213DQ-T1-E3
	16-pin plastic DIP	DG213DJ-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 [d]	640	
	16 pin narrow TSSOP [d]	500	

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)

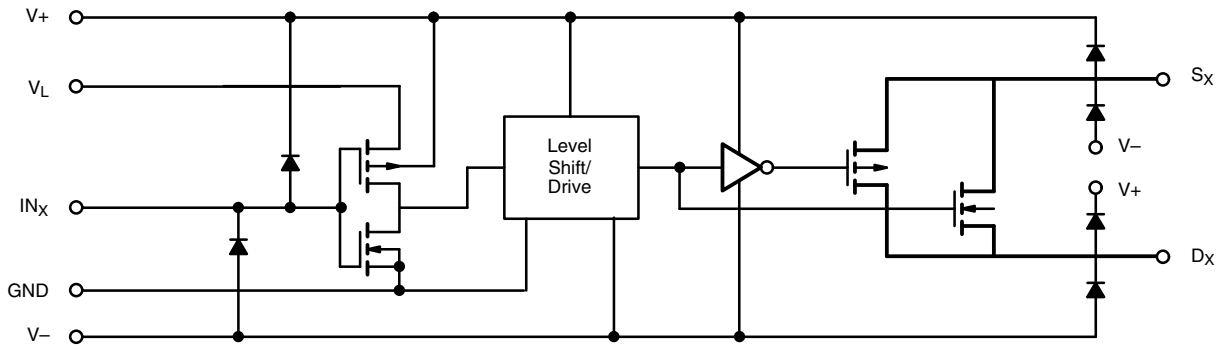


Fig. 1

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. [c]	TYP. [b]	MAX. [c]	
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	-	45	60	Ω
			Full	-	-	85	
$R_{DS(on)}$ match	$\Delta R_{DS(on)}$		Room	-	1	2	
Source off leakage current	$I_{S(off)}$	V_S = ± 14 V, V_D = ± 14 V	Room	-0.5	± 0.01	0.5	nA
			Full	-5	-	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	-	5	
Drain on leakage current	$I_{D(on)}$	V_S = V_D = ± 14 V	Room	-0.5	± 0.02	0.5	
			Full	-10	-	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	-	85	130	ns
Turn-off time	t_{off}		Room	-	55	100	
Turn-off time	t_D	V_S = 10 V, see Fig. 10	Room	15	25	-	
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	-	-	1	µA
			Full	-	-	5	
Negative supply current	I-		Room	-1	-	-	
			Full	-5	-	-	
Logic supply current	I_L		Room	-	-	1	
			Full	-	-	5	
Power supply range for continuous operation	V_{OP}		Full	± 3	-	± 22	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 datasheet
d. Guaranteed by design, not subject to production test
e. V_{IN} = input voltage to perform proper function

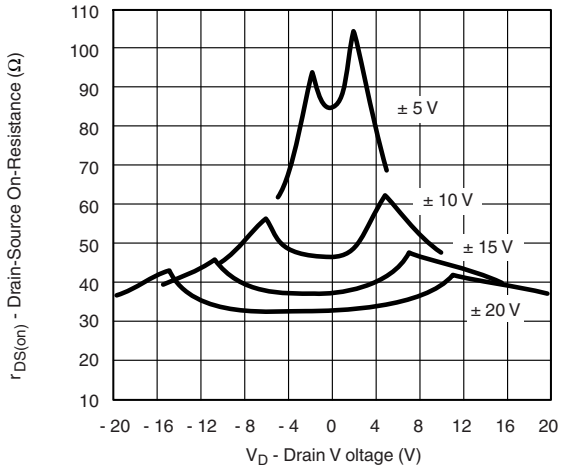
SPECIFICATIONS (for Single Supply)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS UNLESS OTHERWISE SPECIFIED** V+ = 12 V, V- = 0 V V_L = 5 V, V_{IN} = 2.4 V, 0.8 V [e]	**TEMP.[a]**	**D SUFFIX** -40 °C to +85 °C			**UNIT**
				MIN. [c]	**TYP. [b]**	**MAX. [c]**	
Analog Switch							
Analog signal range [d]	V_{ANALOG}		Full	V-	-	V+	V
Drain-source on-resistance	$R_{DS(on)}$	V_D = 3 V, I_S = 1 mA	Room	-	90	110	Ω
			Full	-	-	140	
Dynamic Characteristics							
Turn-on time	t_{on}	See Fig. 9	Room	-	125	200	ns
Turn-off time	t_{off}		Room	-	45	100	
Break-before-make time delay	t_D	V_S = 8 V, see Fig. 10	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 V or 5 V	Room	-	-	1	µA
			Full	-	-	5	
Negative supply current	I-		Room	-1	-	-	
			Full	-5	-	-	
Logic supply current	I_L		Room	-	-	1	
			Full	-	-	5	
Power supply range for continuous operation	V_{OP}		Full	+ 3	-	+ 40	V

Notes

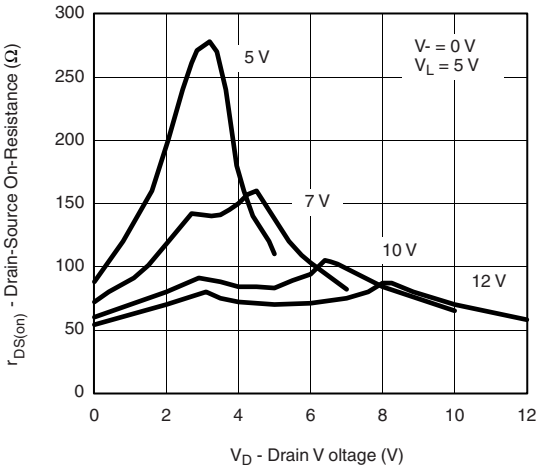
a. Room = 25 °C, full = as determined by the operating temperature suffix
b. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing
c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet
d.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

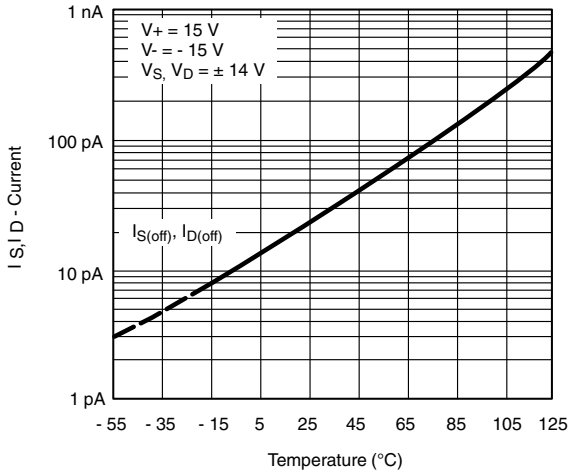


$R_{DS(on)}$ vs. V_D and Power Supply Voltages

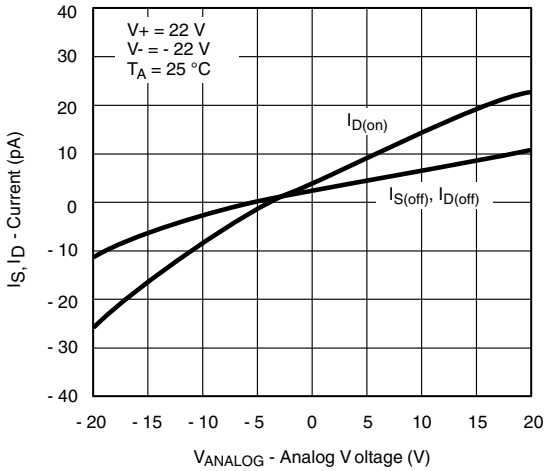


$R_{DS(on)}$ vs. V_D and Single Power Supply Voltages

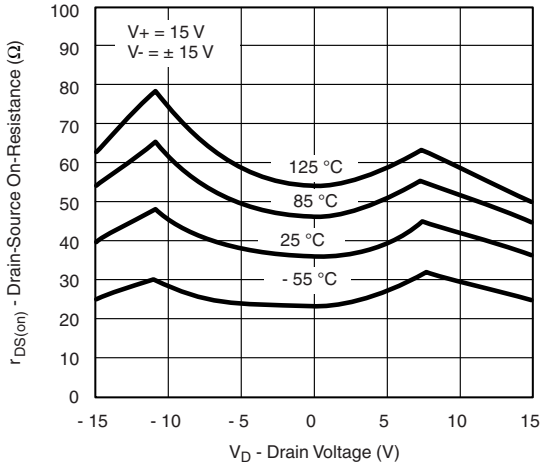
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



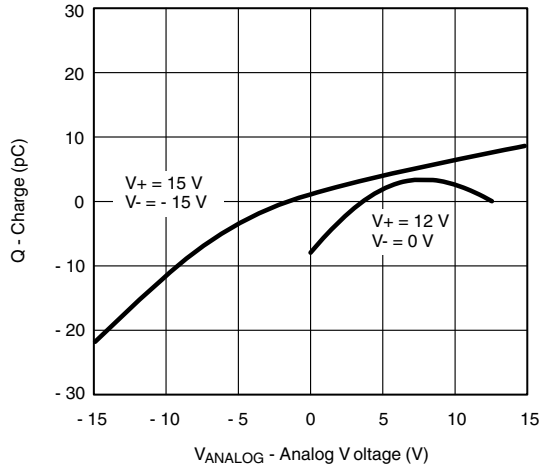
Leakage Current vs. Temperature



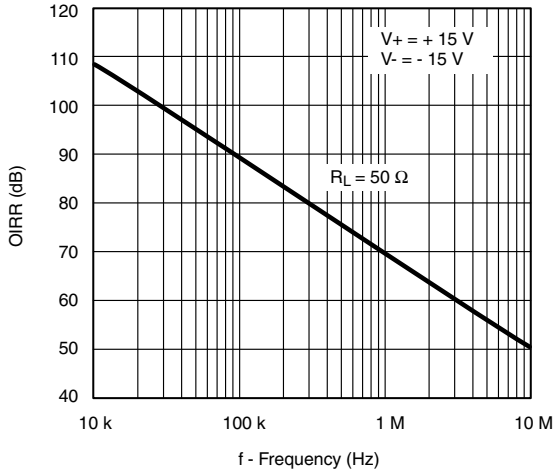
Leakage Currents vs. Analog Voltage



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

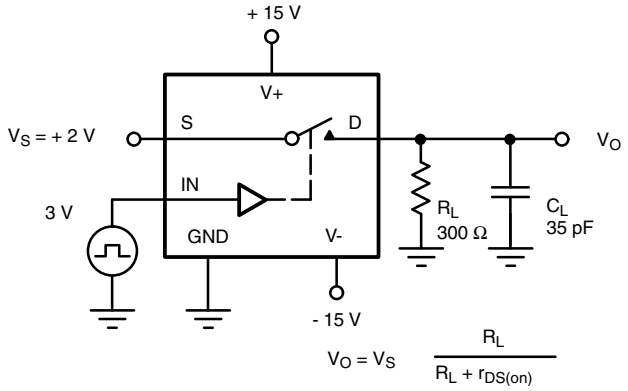


Q_S, Q_D - Charge Injection vs. Analog Voltage



Off Isolation vs. Frequency

TEST CIRCUITS



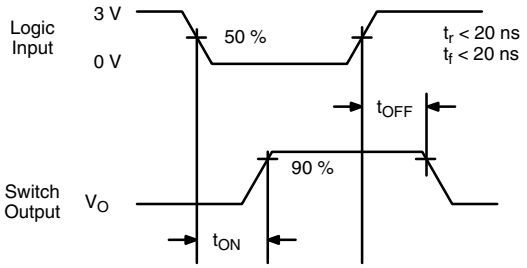
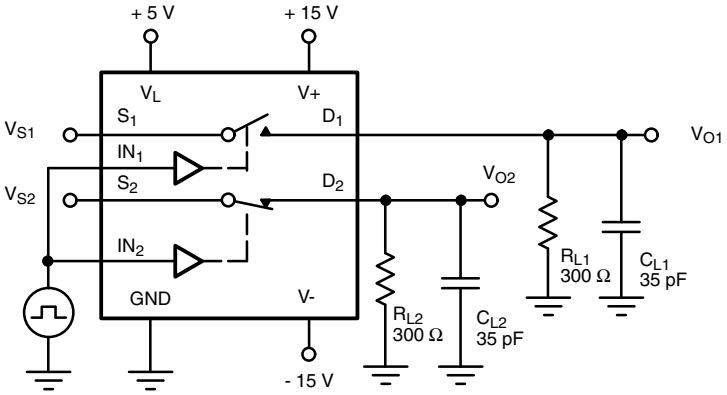
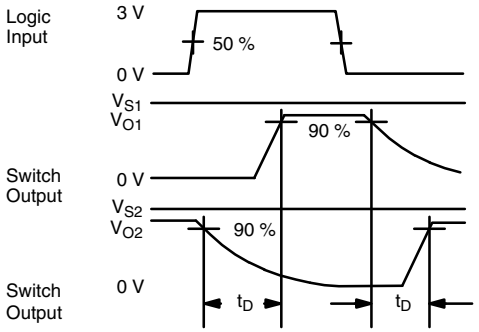


Fig. 2 - Switching Time





C_L (includes fixture and stray capacitance)

Fig. 3 - Break-Before-Make

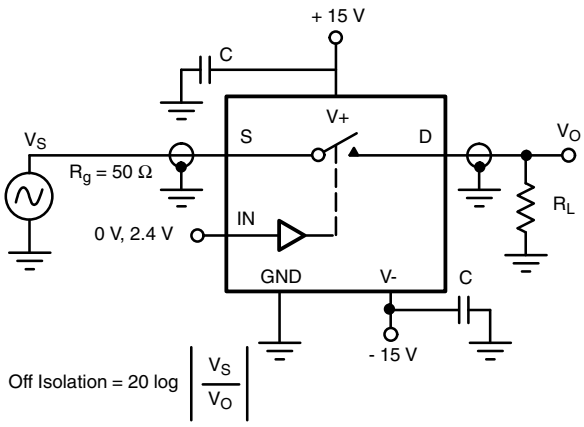


Fig. 4 - Off Isolation

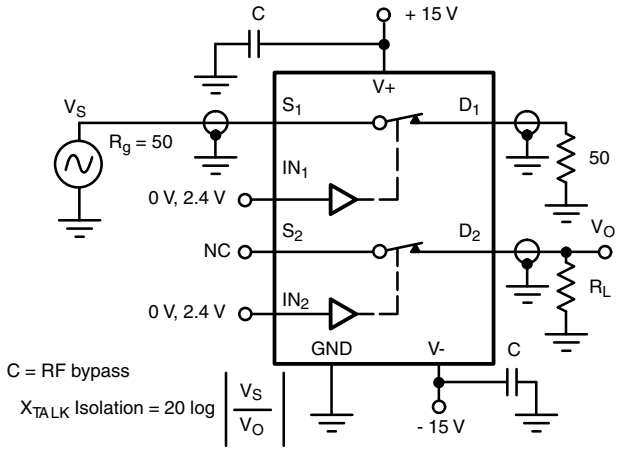
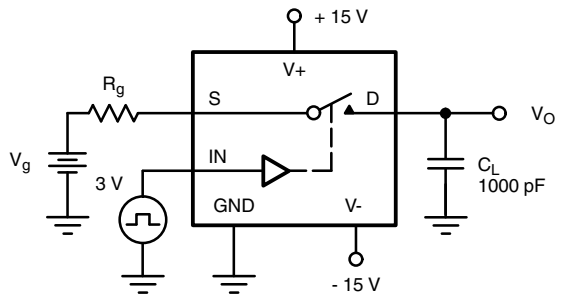
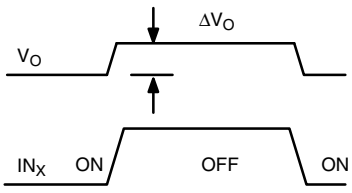


Fig. 5 - Channel-to-Channel Crosstalk

TEST CIRCUITS





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

Fig. 6 - Charge Injection

APPLICATIONS

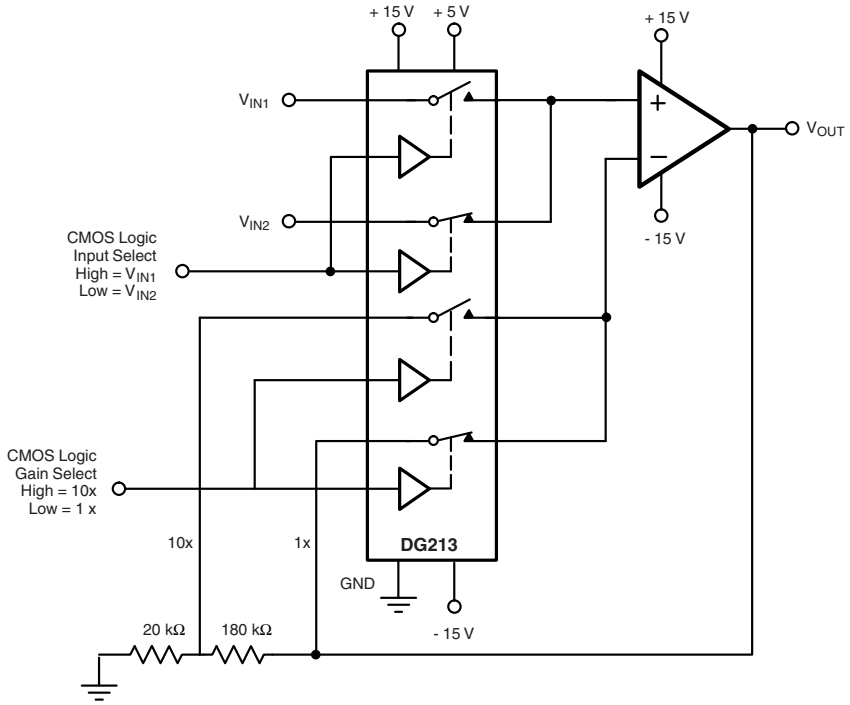


Fig. 7 - Low Power Non-Inverting Amplifier with Digitally Selectable Inputs and Gain

PRODUCT SUMMARY			
Part number	DG213	DG213	DG213
Status code	2	2	2
Configuration	SPST x 4, comp	SPST x 4, comp	SPST x 4, comp
Single supply min. (V)	5	5	5
Single supply max. (V)	36	36	36
Dual supply min. (V)	5	5	5
Dual supply max. (V)	22	22	22
On-resistance (Ω)	45	45	45
Charge injection (pC)	1	1	1
Source on capacitance (pF)	-	-	-
Source off capacitance (pF)	5	5	5
Leakage switch on typ. (nA)	0.02	0.02	0.02
Leakage switch off max. (nA)	0.5	0.5	0.5
-3 dB bandwidth (MHz)	-	-	-
Package	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
Interface	Parallel	Parallel	Parallel
Single supply operation	Yes	Yes	Yes
Dual supply operation	Yes	Yes	Yes
Turn on time max. (ns)	130	130	130
Crosstalk and off isolation	-90	-90	-90

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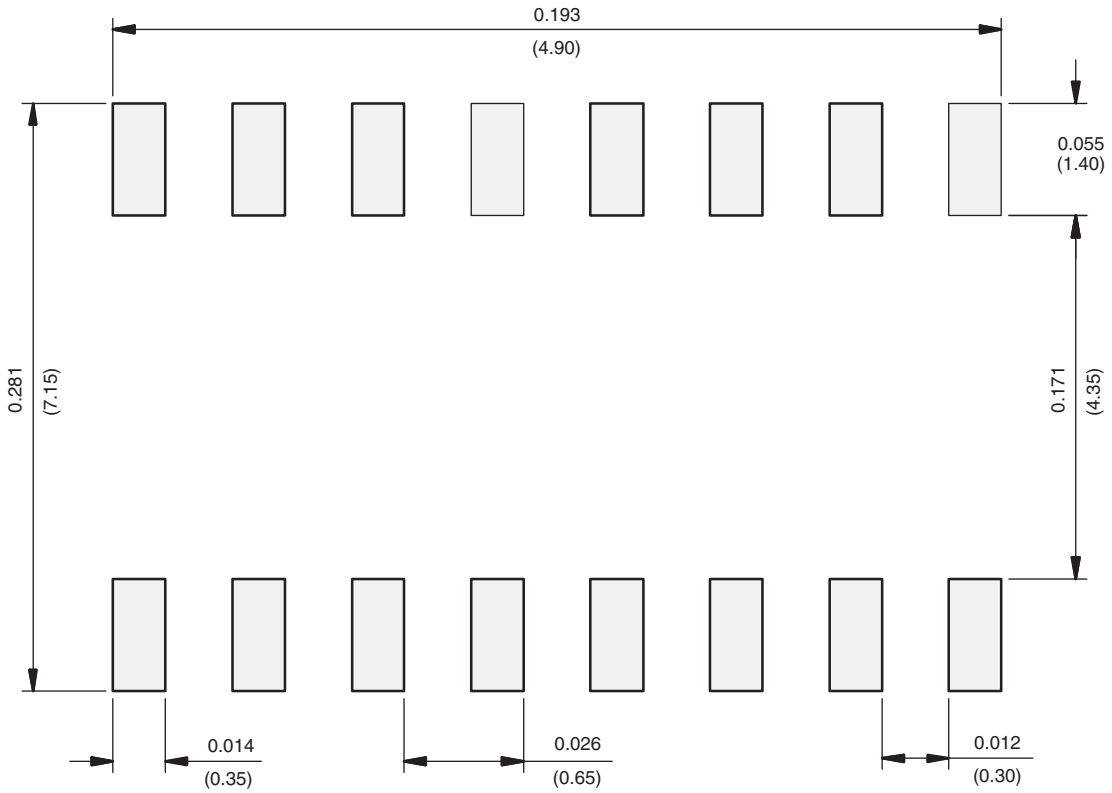
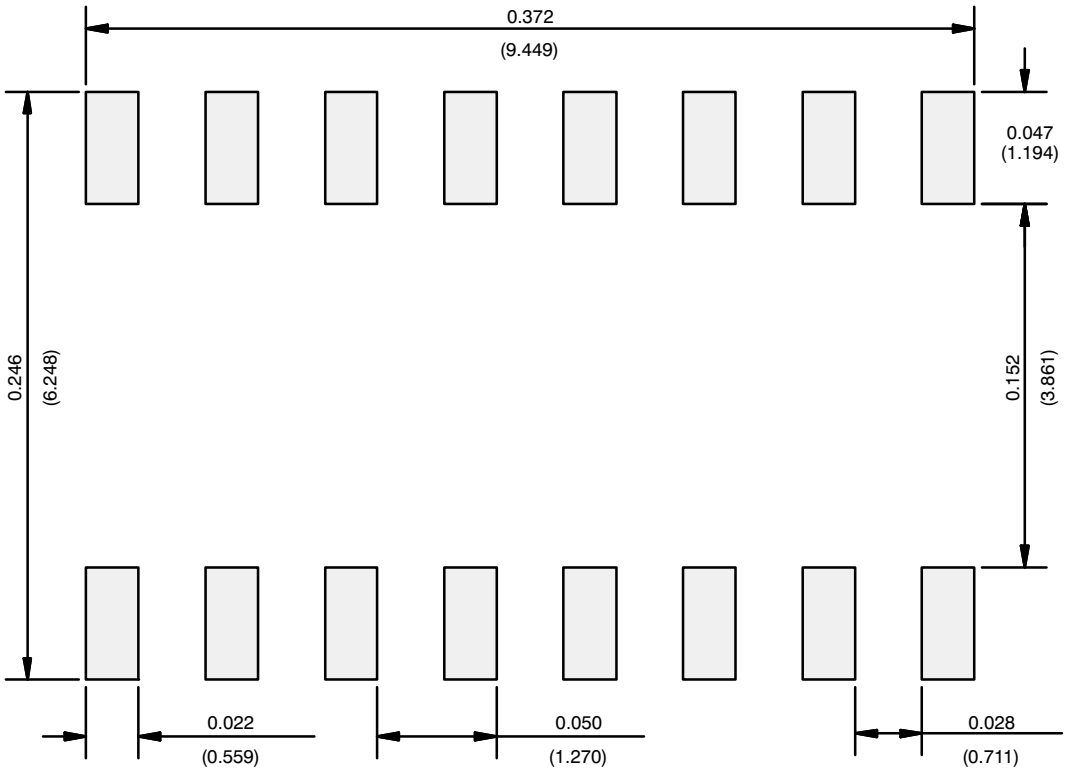
RECOMMENDED MINIMUM PAD FOR TSSOP-16



Recommended Minimum Pads
Dimensions in inches (mm)

RECOMMENDED MINIMUM PADS FOR SO-16



Recommended Minimum Pads
Dimensions in Inches/(mm)

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