

## CMOS Analog Switches

### DESCRIPTION

The DG304B, DG306B and DG307B monolithic CMOS switches were designed for applications in communications, instrumentation and process control. This series is well suited for applications requiring fast switching and nearly flat on-resistance over the entire analog range.

Designed on the Vishay Siliconix PLUS-40 CMOS process to achieve low power consumption and excellent on/off switch performance, these switches are ideal for battery powered applications, without sacrificing switching speed.

Break-before-make switching action is guaranteed, and an epitaxial layer prevents latchup. Single supply operation (for positive switch voltages) is allowed by connecting the V- rail to 0 V.

Each switch conducts equally well in both directions when on, and blocks up to the supply voltage when off. These switches are CMOS input compatible.

### FEATURES

- $\pm 15$  V input range
- Fast switching -  $t_{ON}$ : 110 ns
- Low  $R_{DS(on)}$ : 30  $\Omega$
- Single supply operation
- CMOS logic levels
- Micropower: 30 nW

### BENEFITS

- Full rail-to-rail analog signal range
- Low signal error
- Wide dynamic range
- Low power dissipation

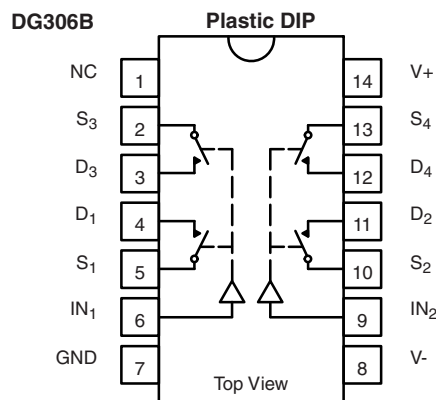
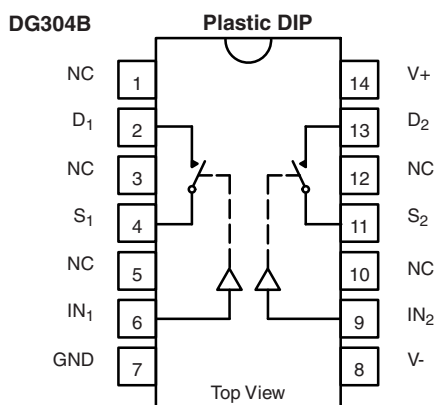
### APPLICATIONS

- Low level switching circuits
- Programmable gain amplifiers
- Portable and battery powered systems



Available  
**RoHS\***  
COMPLIANT

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



#### TRUTH TABLE

Logic	Switch
0	OFF
1	ON

Logic "0"  $\leq 3.5$  V  
Logic "1"  $\geq 11$  V

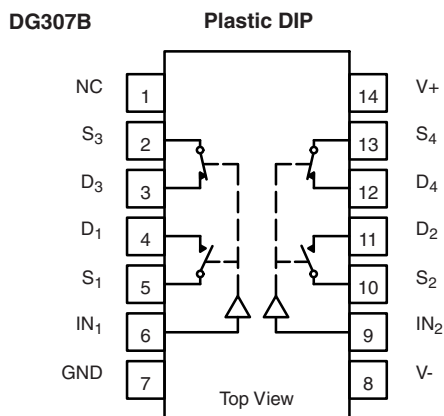
#### TRUTH TABLE

Logic	Switch
0	OFF
1	ON

Logic "0"  $\leq 3.5$  V  
Logic "1"  $\geq 11$  V

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

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Four SPST switches per package

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

Logic "0" ≤ 3.5 V

Logic "1" ≥ 11 V

ORDERING INFORMATION			
Temp. Range	Package	Standard Part Number	Lead (Pb)-free Part Number
- 40 °C to 85 °C	14-Pin Plastic DIP	DG304BDJ	DG304BDJ-E3
		DG306BDJ	DG306BDJ-E3
		DG307BDJ	DG307BDJ-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
Continuous Current, S or D (Pulsed at 1 ms, 10 % duty cycle max.)		100	
Storage Temperature		- 65 to 150	°C
Power Dissipation <sup>b</sup>	14-Pin Plastic DIP <sup>c</sup>	470	mW

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 11 mW/°C above 25 °C.

**SPECIFICATIONS<sup>a</sup>**

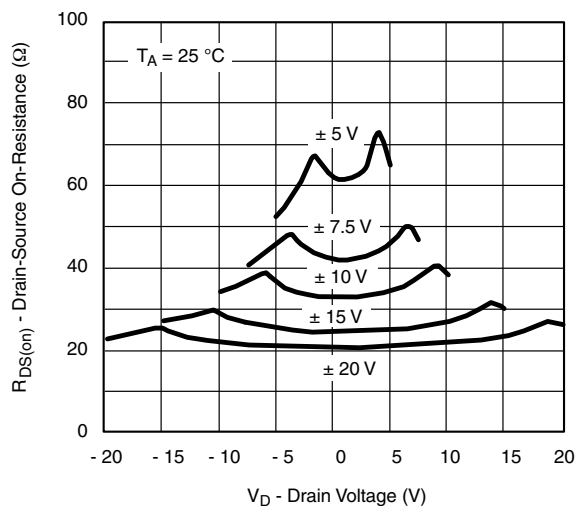
Parameter	Symbol	Test Conditions Unless Otherwise Specified V <sub>+</sub> = 15 V, V <sub>-</sub> = - 15 V V <sub>IN</sub> = 3.5 V or 11 V <sup>f</sup>	Temp. <sup>b</sup>	Limits - 40 °C to 85 °C			Unit
				Min. <sup>d</sup>	Typ. <sup>c</sup>	Max. <sup>d</sup>	
Analog Switch							
Analog Signal Range <sup>e</sup>	V <sub>ANALOG</sub>		Full	- 15		15	V
Drain-Source On-Resistance	R <sub>DS(on)</sub>	V <sub>D</sub> = ± 10 V, I <sub>S</sub> = 10 mA	Room Full		30	50 75	Ω
Source Off Leakage Current	I <sub>S(off)</sub>	V <sub>S</sub> = ± 14 V, V <sub>D</sub> = ± 14 V	Room Full	- 5 - 100	± 0.1	5 100	nA
Drain Off Leakage Current	I <sub>D(off)</sub>		Room Full	- 5 - 100	± 0.1	5 100	
Drain On Leakage Current	I <sub>D(on)</sub>	V <sub>D</sub> = V <sub>S</sub> = ± 14 V	Room Full	- 5 - 200	± 0.1	5 200	
Digital Control							
Input Current with Input Voltage High	I <sub>INH</sub>	V <sub>IN</sub> = 5 V	Room Full	- 1	- 0.001		μA
		V <sub>IN</sub> = 15 V	Room Full		0.001	1	
Input Current with Input Voltage Low	I <sub>INL</sub>	V <sub>IN</sub> = 0 V	Room Full	- 1	- 0.001		
Dynamic Characteristics							
Turn-On Time	t <sub>ON</sub>	see figure 2	Room		110		ns
Turn-Off Time	t <sub>OFF</sub>		Room		70		
Break-Before-Make Time	t <sub>OPEN</sub>	DG305A/307A ONLY, see figure 3	Room		50		
Charge Injection	Q	C <sub>L</sub> = 1 nF, R <sub>gen</sub> = 0 Ω, V <sub>gen</sub> = 0 V see figure 4	Room		30		pC
Source-Off Capacitance	C <sub>S(off)</sub>	V <sub>S</sub> , V <sub>D</sub> = 0 V, f = 1 MHz	Room		14		pF
Drain-Off Capacitance	C <sub>D(off)</sub>		Room		14		
Channel-On Capacitance	C <sub>D(on)</sub>		Room		40		
Input Capacitance	C <sub>IN</sub>	f = 1 MHz	V <sub>IN</sub> = 0 V Room		6		
			V <sub>IN</sub> = 15 V Room		7		
Off-Isolation	OIRR	V <sub>IN</sub> = 0 V, R <sub>L</sub> = 1 kΩ	Room		62		dB
Crosstalk (Channel-to-Channel)	X <sub>TALK</sub>	V <sub>S</sub> = 1 V <sub>rms</sub> , f = 500 kHz	Room		74		
Power Supplies							
Positive Supply Current	I <sub>+</sub>	V <sub>IN</sub> = 15 V or 0 V (all inputs)	Room Full		0.001	100	μA
Negative Supply Current	I <sub>-</sub>		Room Full	- 100	- 0.001		

## Notes:

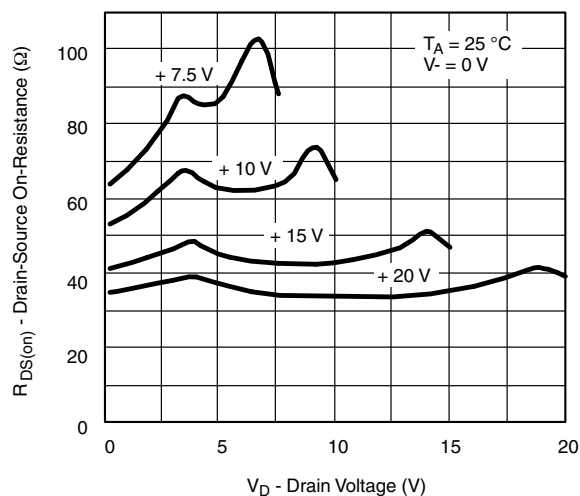
- Refer to PROCESS OPTION FLOWCHART.
- Room = 25 °C, Full = as determined by the operating temperature suffix.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum,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

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.

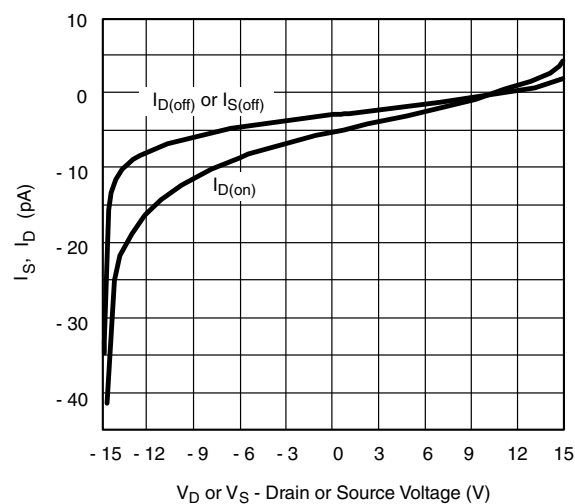
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



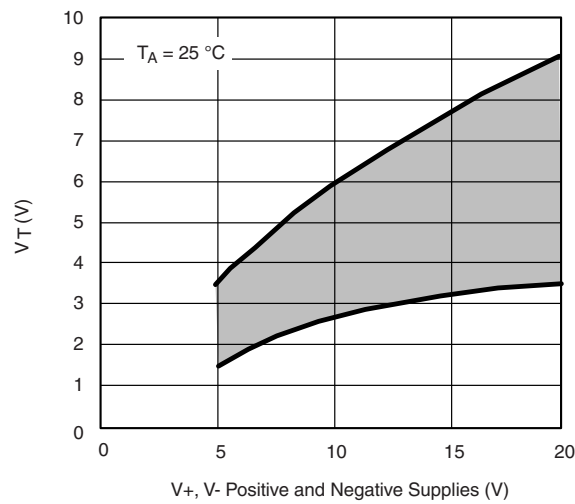
$R_{DS(on)}$  vs.  $V_D$  and  $\pm$  Power Supply



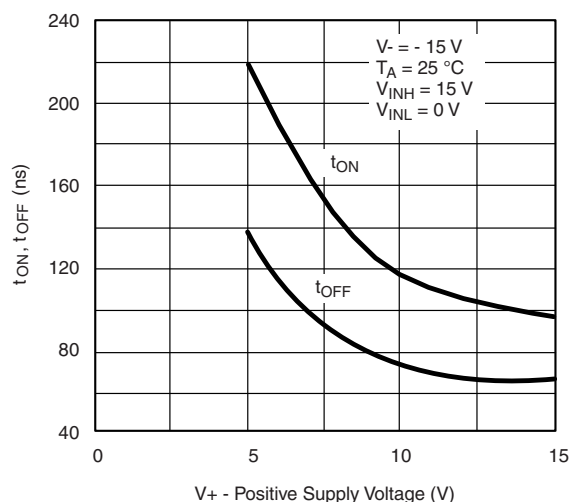
$R_{DS(on)}$  vs.  $V_D$  and  $+$  Power Supply Voltage



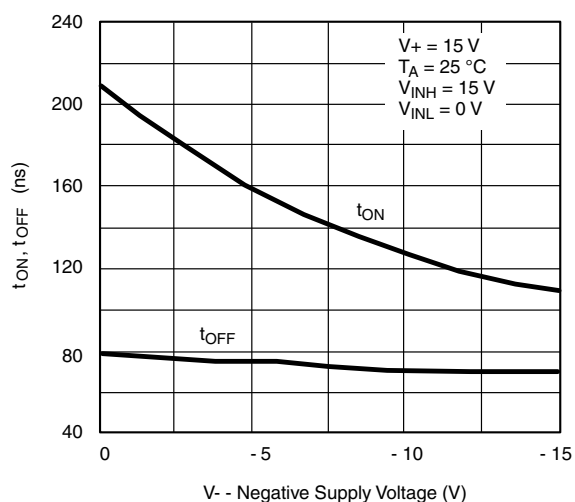
Leakage Currents vs. Analog Voltage



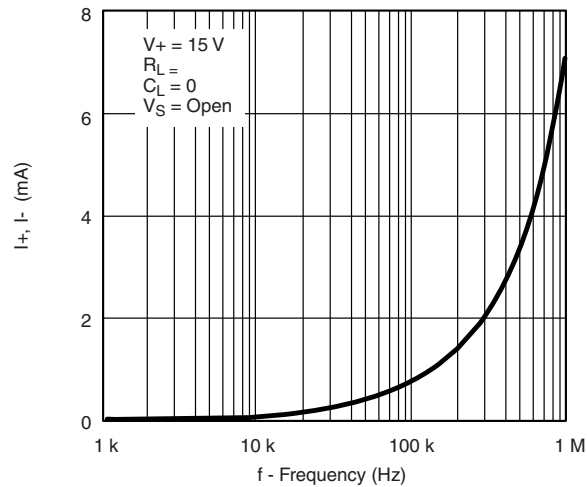
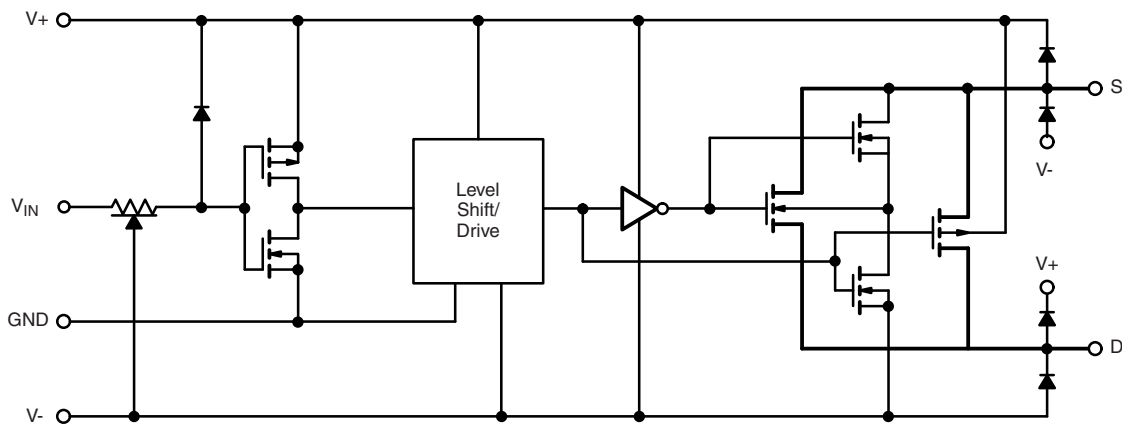
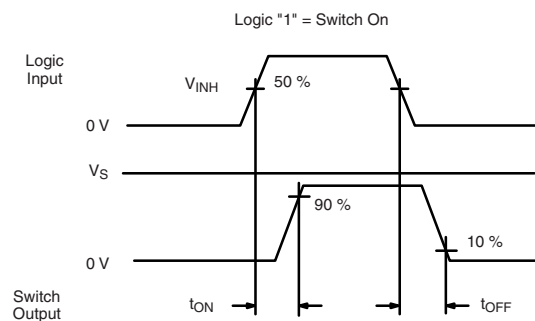
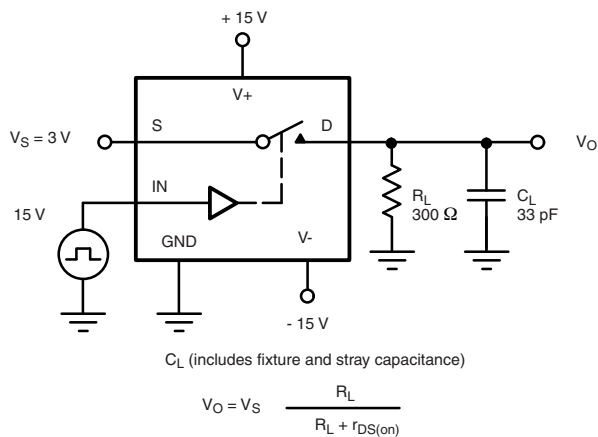
Input Switching Threshold vs.  $V_+$  and  $V_-$  Supply Voltages



Switching Time vs. Positive Supply Voltage



Switching Time vs. Negative Supply Voltage

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Supply Currents vs. Toggle Frequency**
**SCHEMATIC DIAGRAM** (Typical Channel)

**Figure 1.**
**TEST CIRCUITS**

**Figure 2. Switching Time**

## TEST CIRCUITS

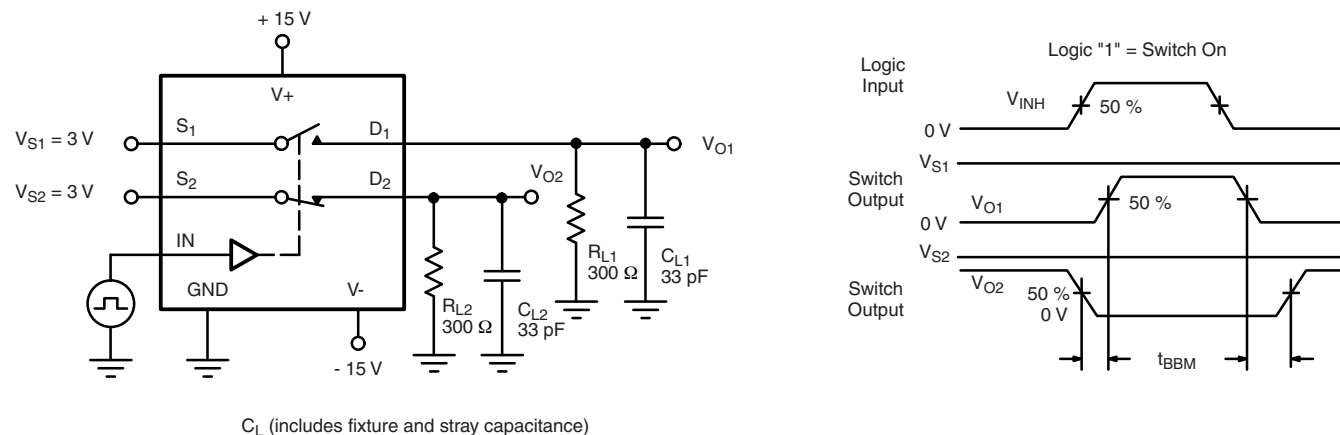


Figure 3. Break-Before-Make SPDT (DG307B)

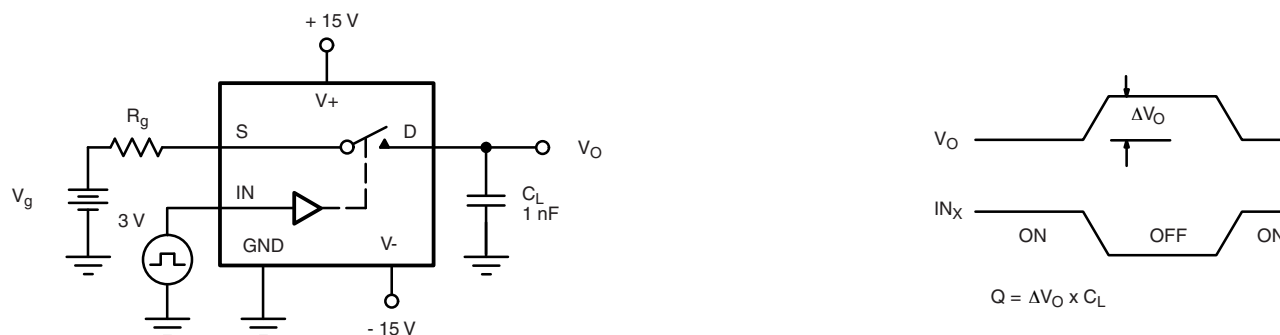


Figure 4. Charge Injection

## APPLICATIONS HINTS<sup>a</sup>

V+ Positive Supply Voltage (V)	V- Negative Supply Voltage (V)	GND Voltage (V)	V <sub>IN</sub> Logic Input Voltage V <sub>INH(min)</sub> /V <sub>INL(max)</sub> (V)	V <sub>S</sub> or V <sub>D</sub> Analog Voltage Range (V)
15	- 15	0	11/3.5	- 15 to 15
20	- 20	0	11/3.5	- 20 to 20
15	0	0	11/3.5	0 to 15

Notes:

a. Application hints are for DESIGN AID ONLY, not guaranteed and not subject to production testing.

## APPLICATIONS

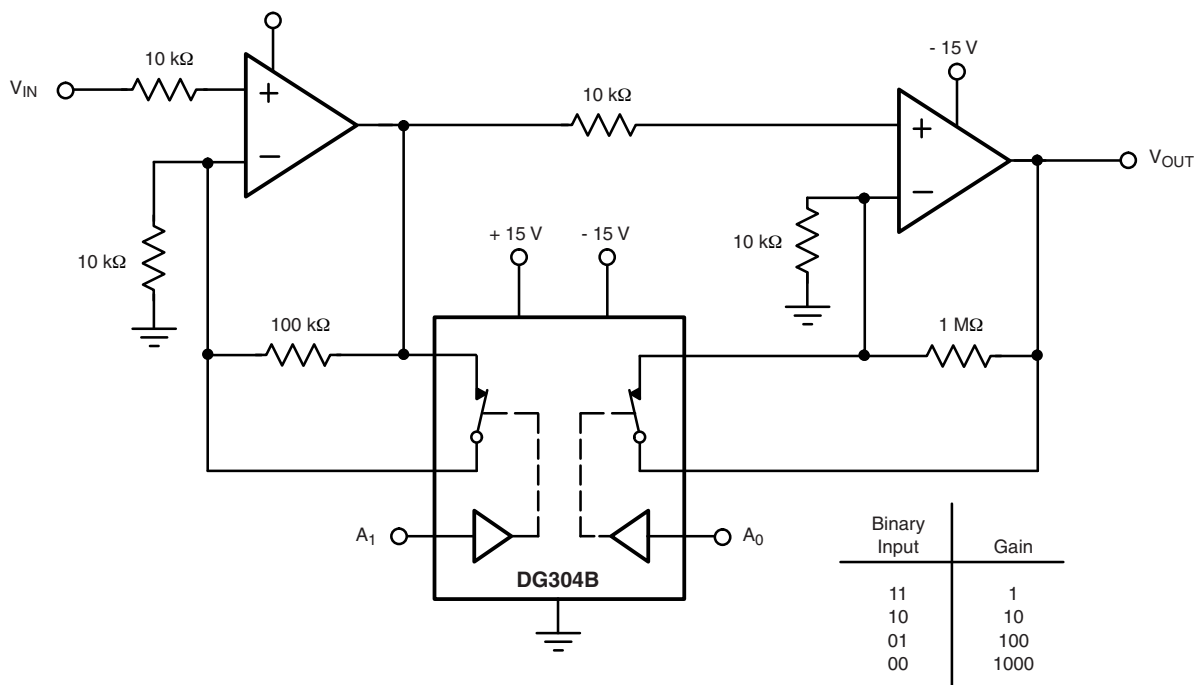


Figure 5. Low Power Binary to  $10^n$  Gain Low Frequency Amplifier

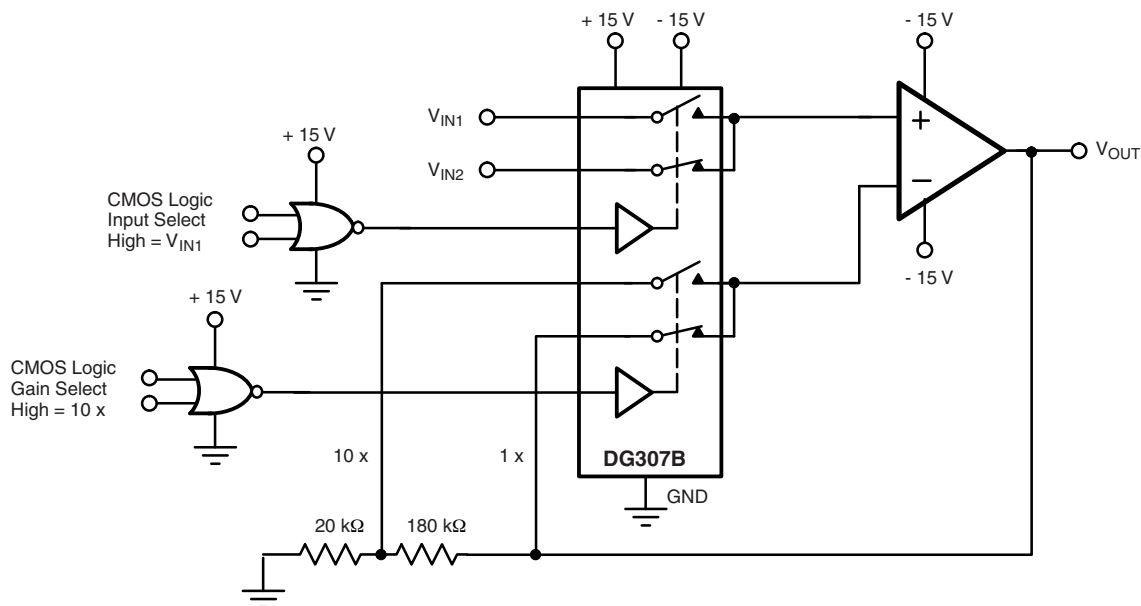
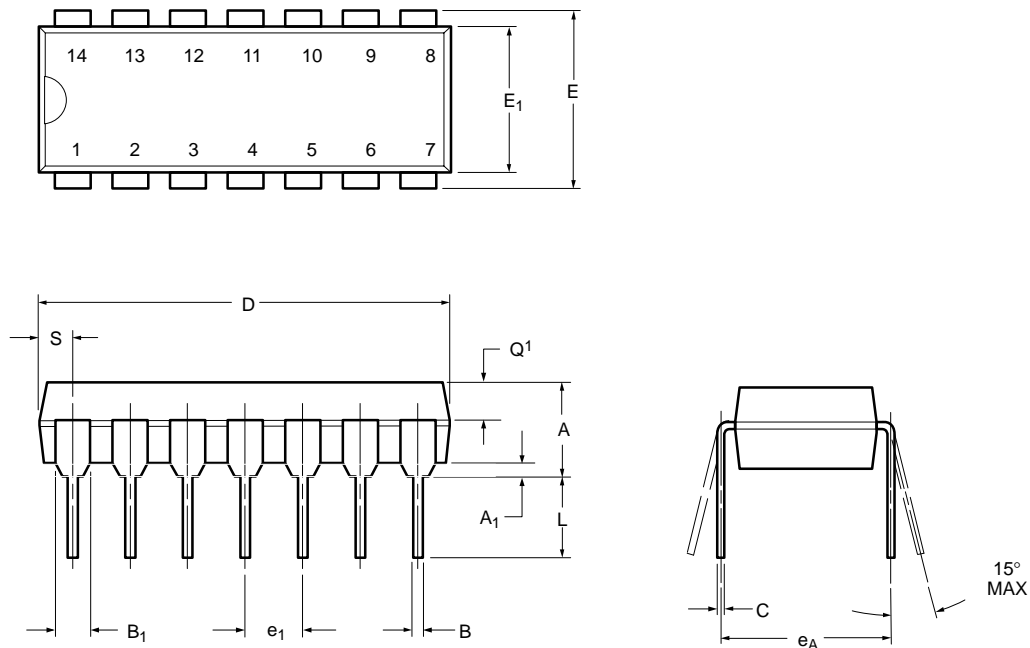


Figure 6. Low Power Instrumentation Amplifier with Digitally Selectable Inputs and Gain

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**PDIP: 14-LEAD**



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	3.81	5.08	0.150	0.200
A <sub>1</sub>	0.38	1.27	0.015	0.050
B	0.38	0.51	0.015	0.020
B <sub>1</sub>	0.89	1.65	0.035	0.065
C	0.20	0.30	0.008	0.012
D	17.27	19.30	0.680	0.760
E	7.62	8.26	0.300	0.325
E <sub>1</sub>	5.59	7.11	0.220	0.280
e <sub>1</sub>	2.29	2.79	0.090	0.110
e <sub>A</sub>	7.37	7.87	0.290	0.310
L	2.79	3.81	0.110	0.150
Q <sub>1</sub>	1.27	2.03	0.050	0.080
S	1.02	2.03	0.040	0.080

ECN: S-03946—Rev. C, 09-Jul-01  
DWG: 5481





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