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

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

Pb-free Available

RoHS* COMPLIANT

BENEFITS

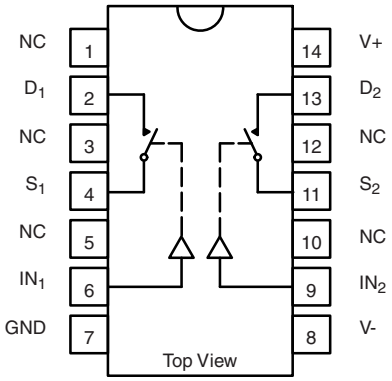
- Full rail-to-rail analog signal range
- Low signal error
- Wide dynamic range
- Low power dissipation

APPLICATIONS

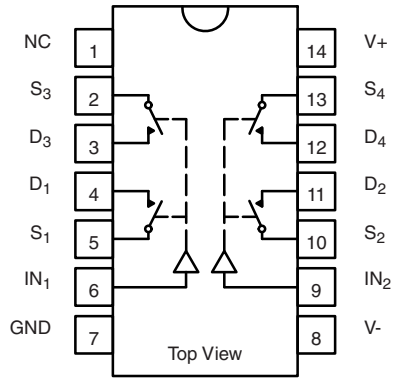
- Low level switching circuits
- Programmable gain amplifiers
- Portable and battery powered systems

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG304B Plastic DIP



DG306B Plastic DIP



TRUTH TABLE	
Logic	**Switch**
0	OFF
1	ON

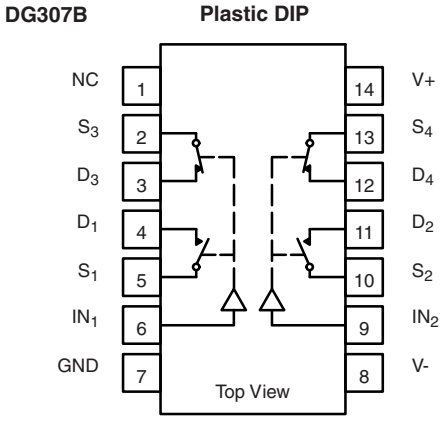
Logic "0" ≤ 3.5 V
Logic "1" ≥ 11 V

TRUTH TABLE	
Logic	**Switch**
0	OFF
1	ON

Logic "0" ≤ 3.5 V
Logic "1" ≥ 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_1, SW_2**	**SW_3, SW_4**
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_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
Continuous Current, S or D (Pulsed at 1 ms, 10 % duty cycle max.)		100	
Storage Temperature		- 65 to 150	°C
Power Dissipation[b]	14-Pin Plastic DIP[c]	470	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 11 mW/°C above 25 °C.

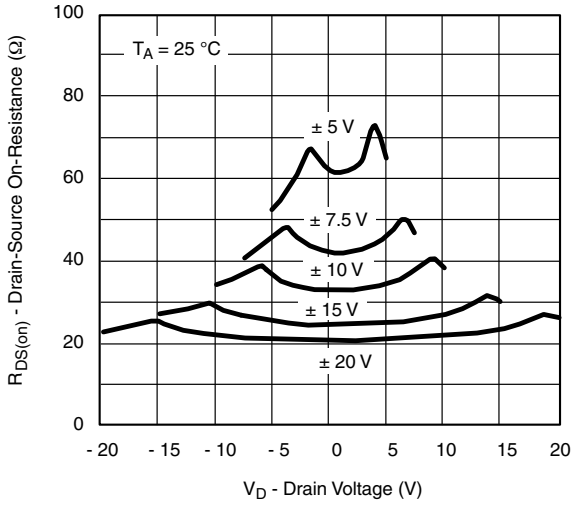
SPECIFICATIONS[a]

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

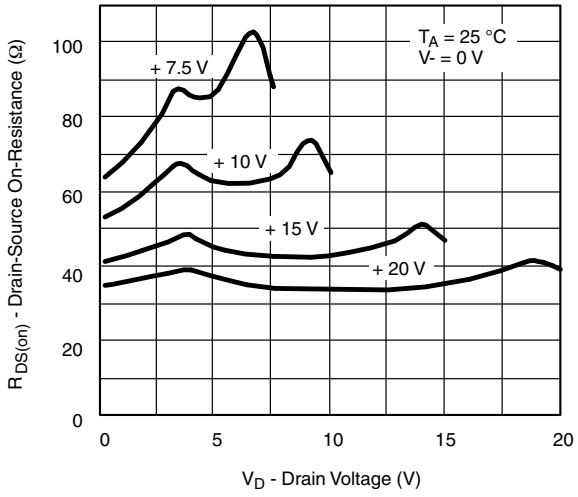
Notes:
a. Refer to PROCESS OPTION FLOWCHART.
b. Room = 25 °C, Full = as determined by the operating temperature suffix.
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum and the most positive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

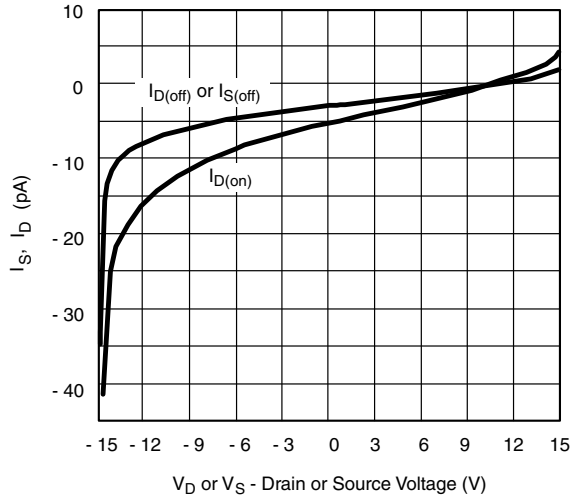
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



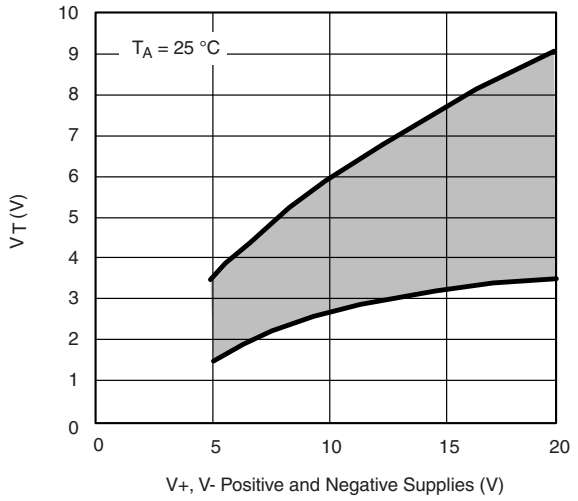
$R_{DS(on)}$ vs. V_D and ± Power Supply



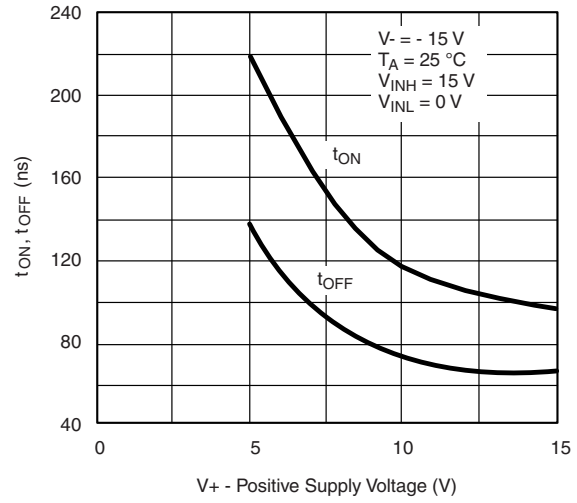
$R_{DS(on)}$ vs. V_D and + Power Supply Voltage



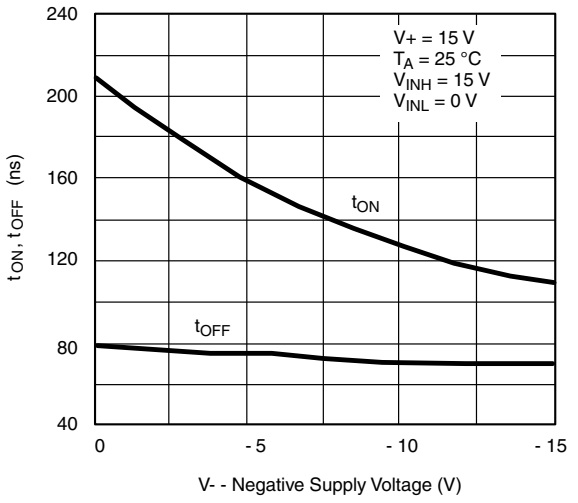
Leakage Currents vs. Analog Voltage



Input Switching Threshold vs. V+ and V- Supply Voltages

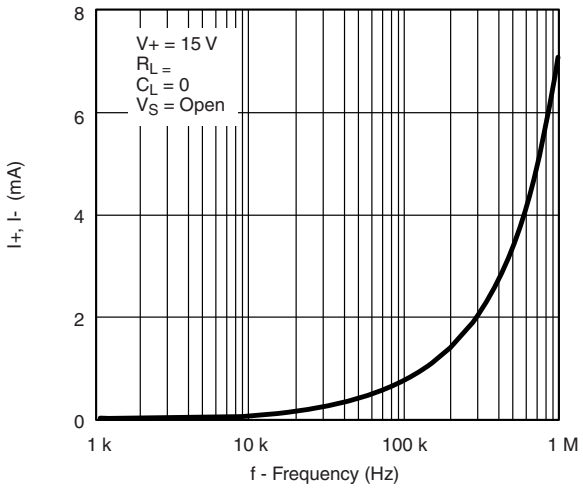


Switching Time vs. Positive Supply Voltage



Switching Time vs. Negative Supply Voltage

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Supply Currents vs. Toggle Frequency

SCHEMATIC DIAGRAM (Typical Channel)

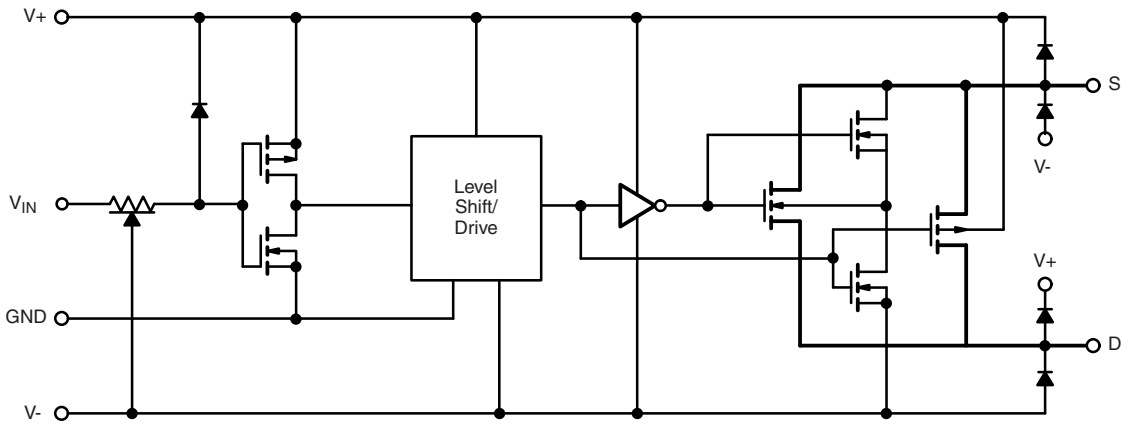
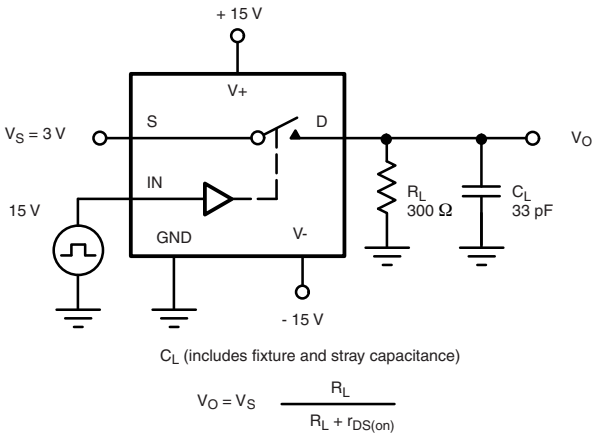


Figure 1.

TEST CIRCUITS



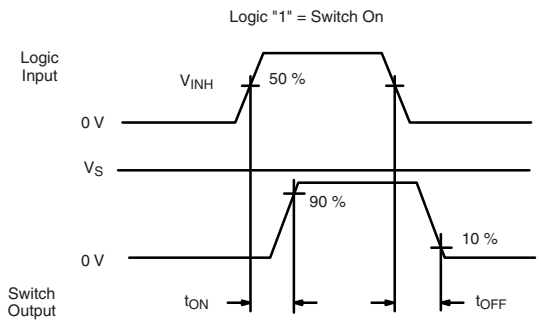


Figure 2. Switching Time

TEST CIRCUITS

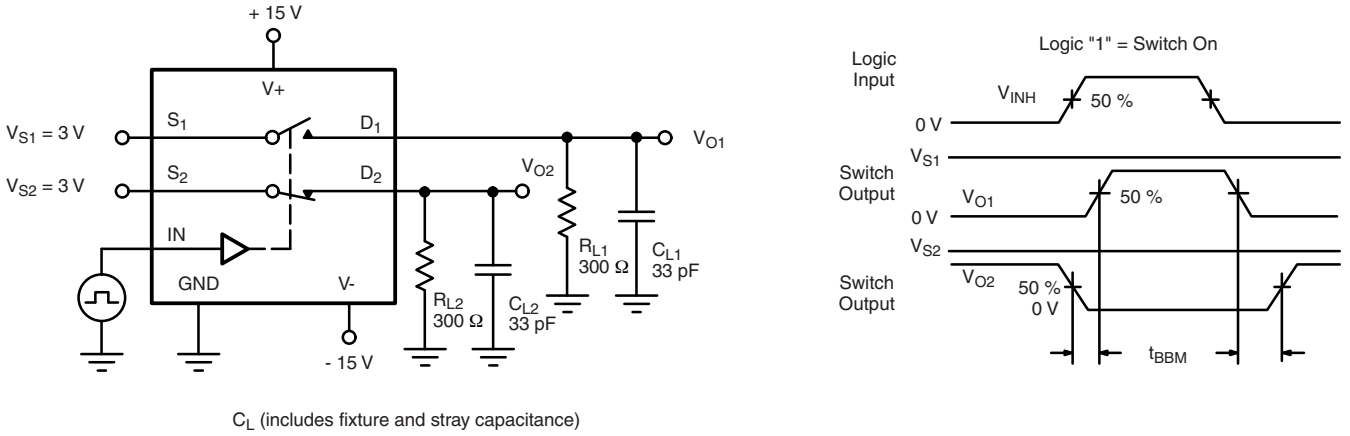


Figure 3. Break-Before-Make SPDT (DG307B)

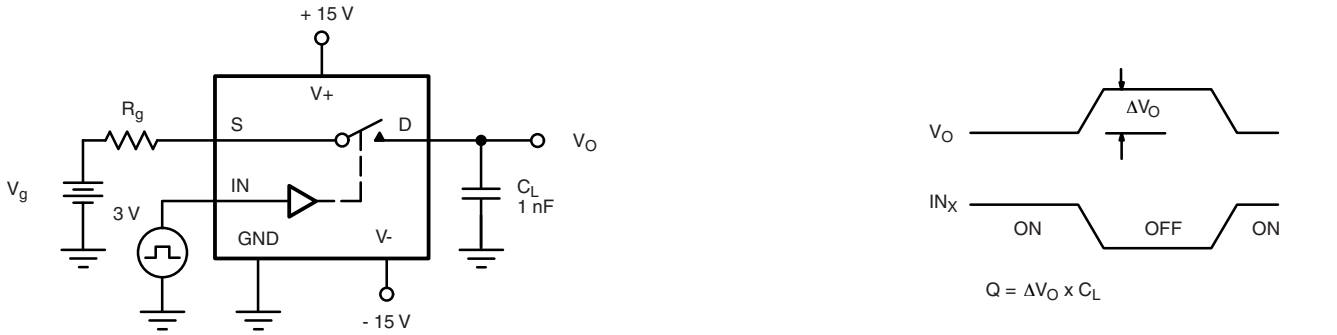


Figure 4. Charge Injection

APPLICATIONS HINTS[a]				
V+ Positive Supply Voltage (V)	V- Negative Supply Voltage (V)	GND Voltage (V)	V_{IN} Logic Input Voltage $V_{INH(min)}/V_{INL(max)}$ (V)	V_S or V_D 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

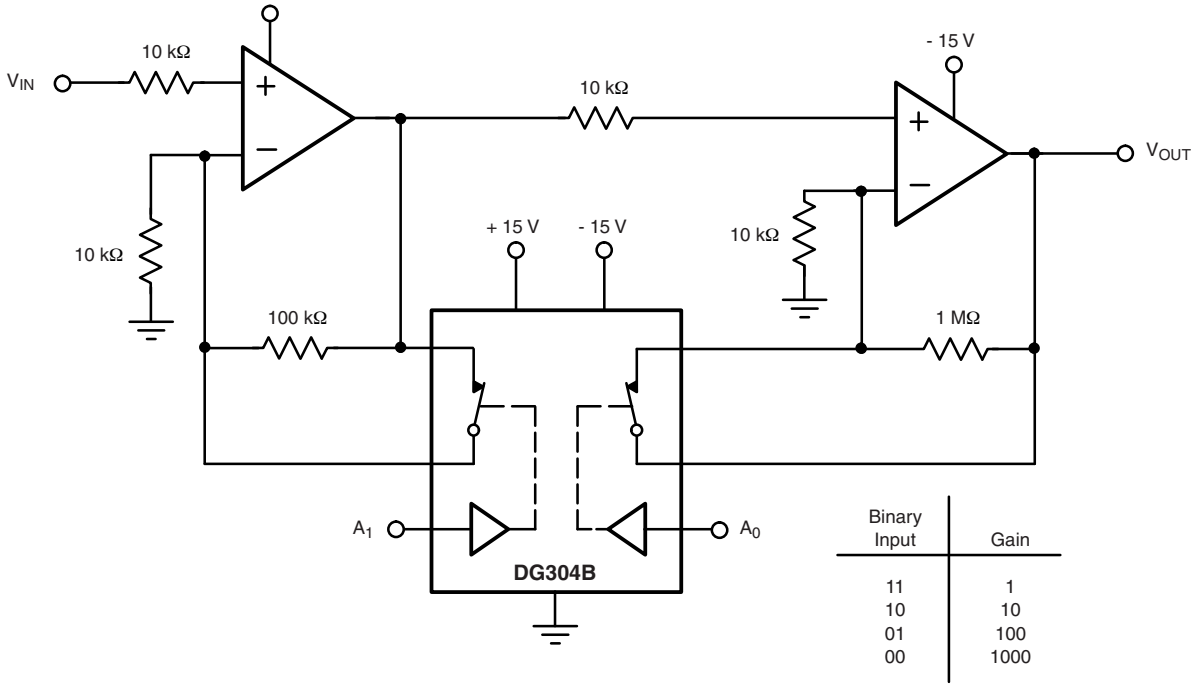


Figure 5. Low Power Binary to 10^n Gain Low Frequency Amplifier

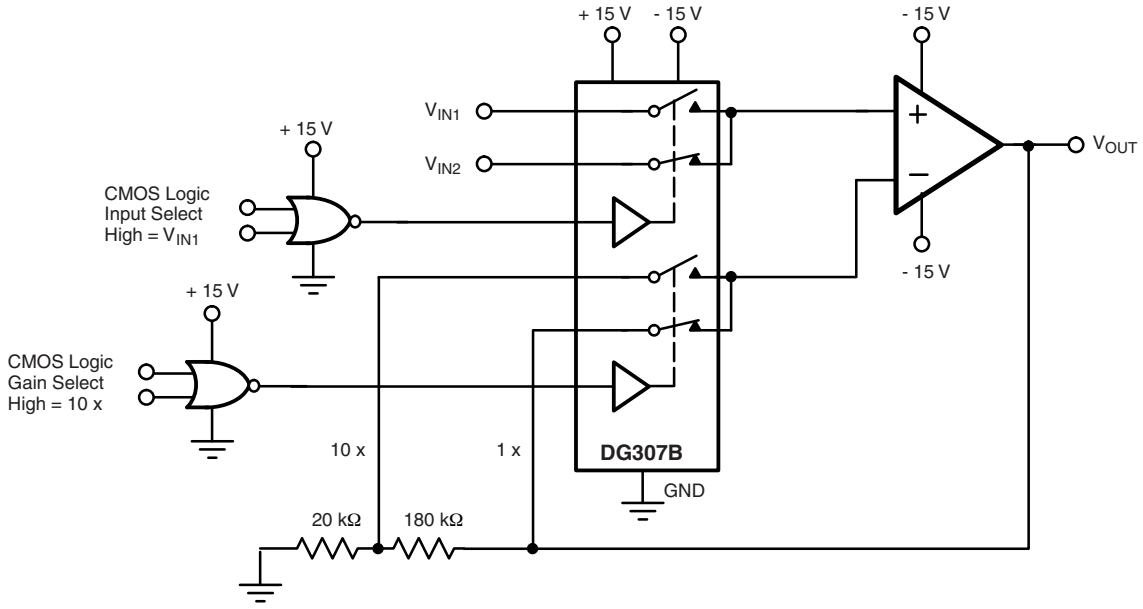


Figure 6. Low Power Instrumentation Amplifier with Digitally Selectable Inputs and Gain

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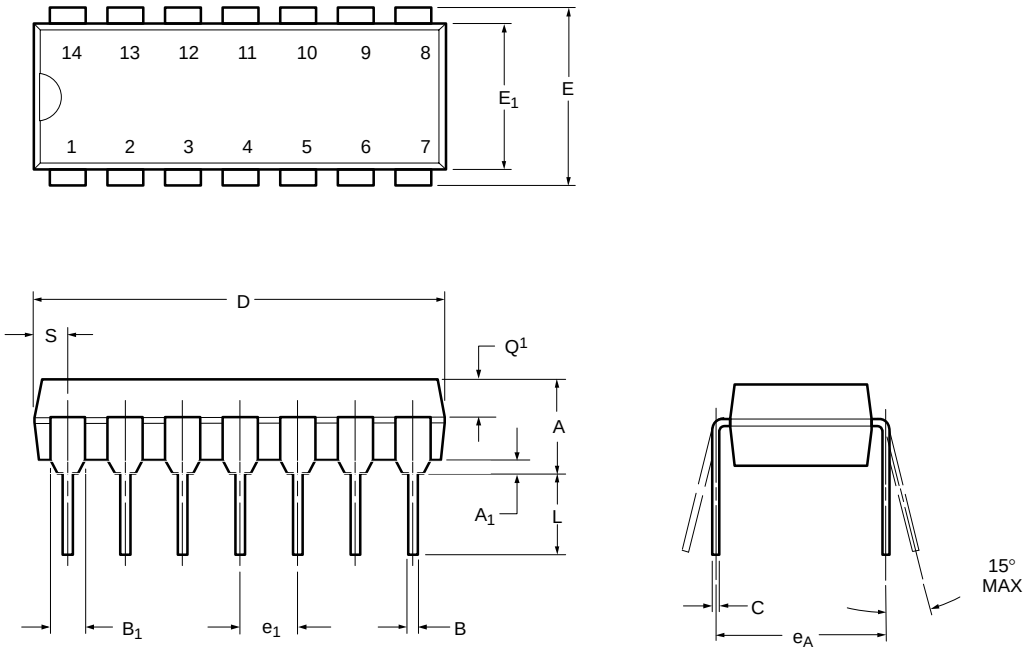
PDIP: 14-LEAD



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	3.81	5.08	0.150	0.200
A_1	0.38	1.27	0.015	0.050
B	0.38	0.51	0.015	0.020
B_1	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_1	5.59	7.11	0.220	0.280
e_1	2.29	2.79	0.090	0.110
e_A	7.37	7.87	0.290	0.310
L	2.79	3.81	0.110	0.150
Q_1	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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