

## 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

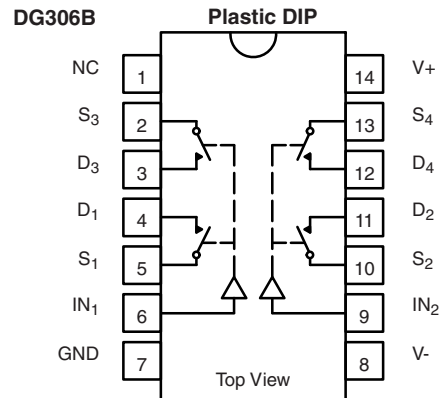
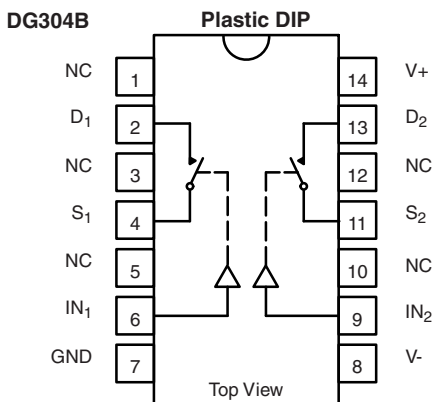
### APPLICATIONS

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



**RoHS\***  
COMPLIANT

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



TRUTH TABLE	
Logic	Switch
0	OFF
1	ON

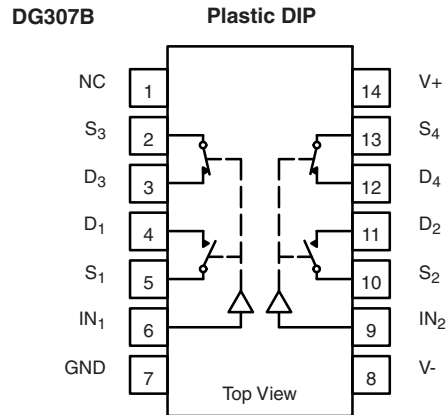
Logic "0"  $\leq 3.5$  V  
Logic "1"  $\geq 11$  V

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:

- 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.
- All leads welded or soldered to PC board.
- Derate 11 mW/°C above 25 °C.



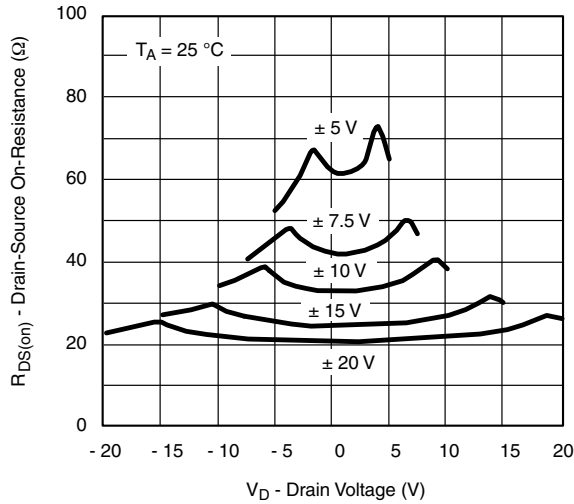
SPECIFICATIONS <sup>a</sup>							
Parameter	Symbol	Test Conditions Unless Otherwise Specified V <sub>+</sub> = 15 V, V <sub>-</sub> = -15 V V <sub>IN</sub> = 3.5 V or 11 V <sup>f</sup>	Temp. <sup>b</sup>	Limits -40 °C to 85 °C			Unit
				Min. <sup>d</sup>	Typ. <sup>c</sup>	Max. <sup>d</sup>	
<b>Analog Switch</b>							
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	
<b>Digital Control</b>							
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		
<b>Dynamic Characteristics</b>							
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	
<b>Power Supplies</b>							
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:

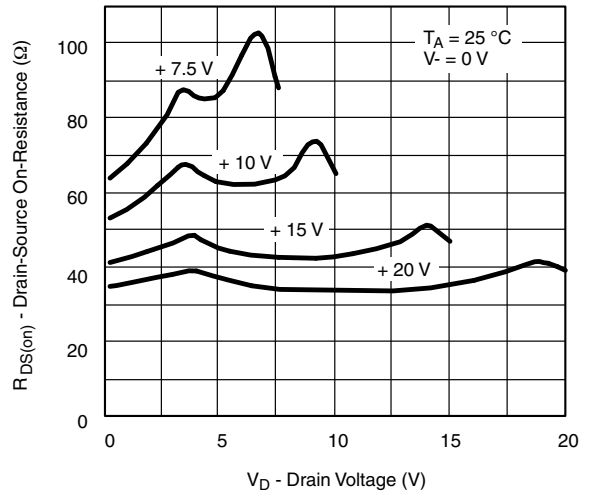
- a. Refer to PROCESS OPTION FLOWCHART.
- b. Room = 25 °C, Full = as determined by the operating temperature suffix.
- c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- d. The algebraic convention whereby the most negative value is a minimum and the most positive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

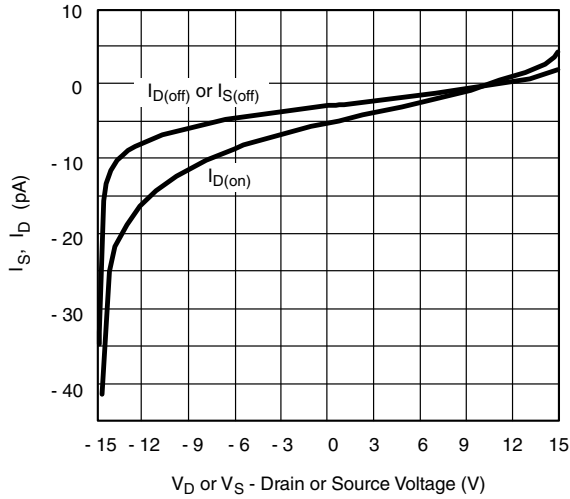
### TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



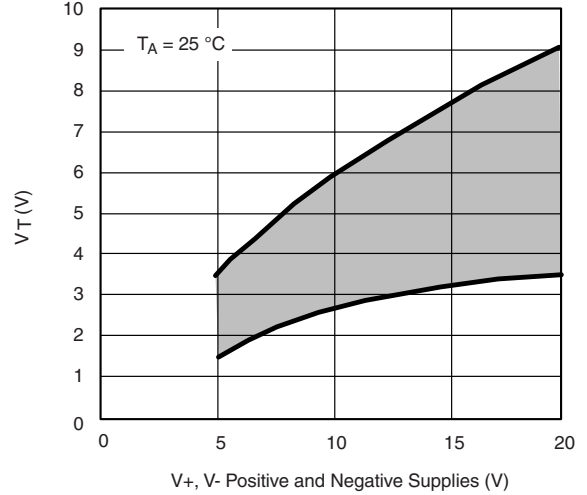
**$R_{DS(on)}$  vs.  $V_D$  and  $\pm$  Power Supply**



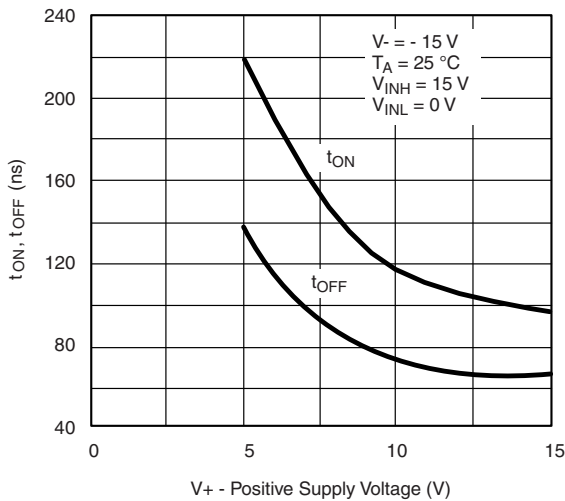
**$R_{DS(on)}$  vs.  $V_D$  and + Power Supply Voltage**



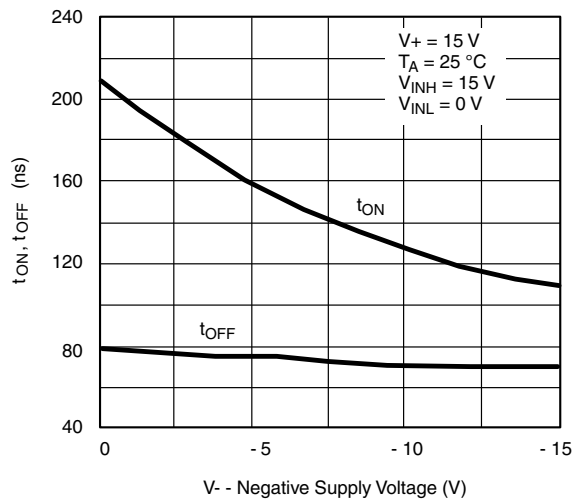
**Leakage Currents vs. Analog Voltage**



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

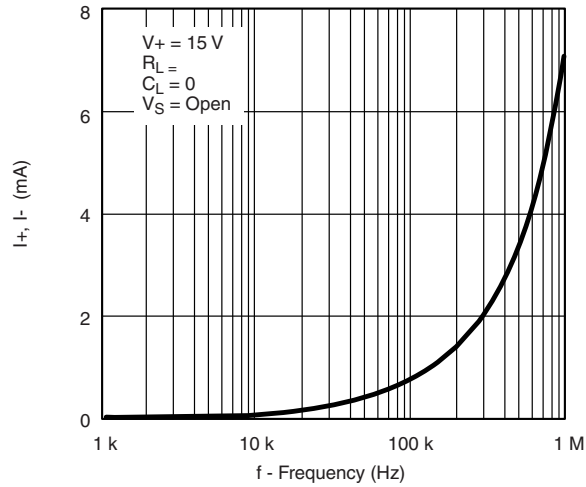


**Switching Time vs. Positive Supply Voltage**



**Switching Time vs. Negative Supply Voltage**

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



Supply Currents vs. Toggle Frequency

**SCHEMATIC DIAGRAM** (Typical Channel)

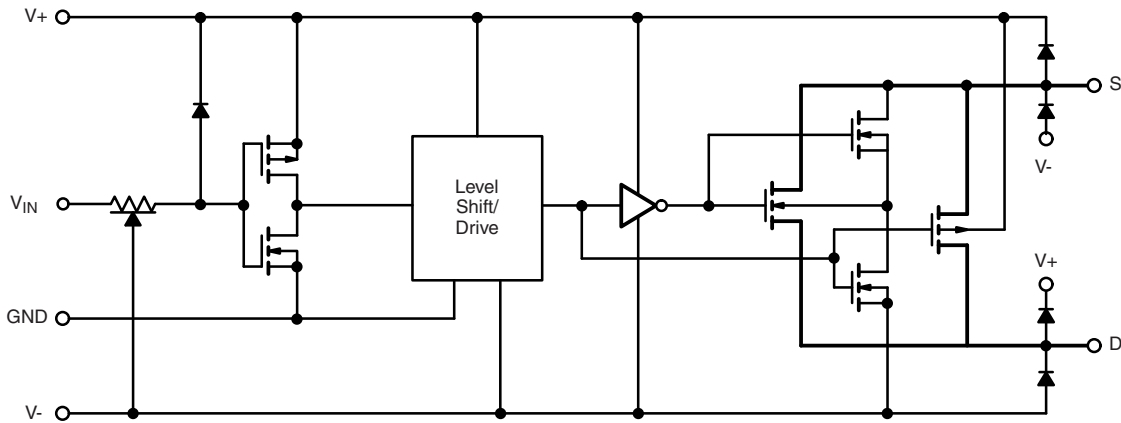


Figure 1.

**TEST CIRCUITS**

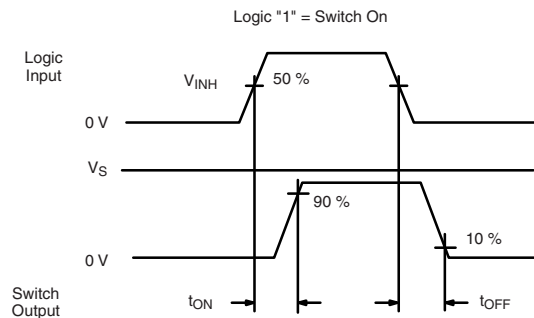
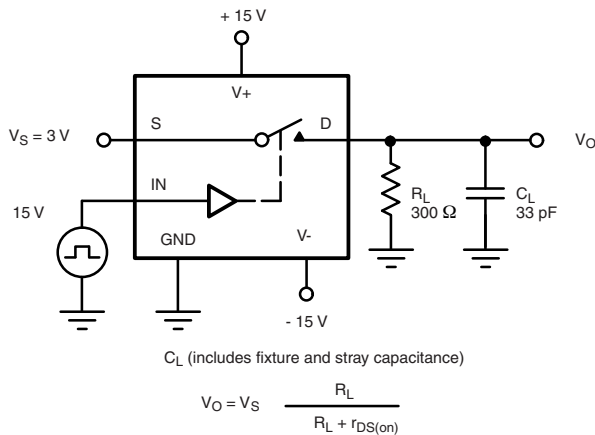


Figure 2. Switching Time

### TEST CIRCUITS

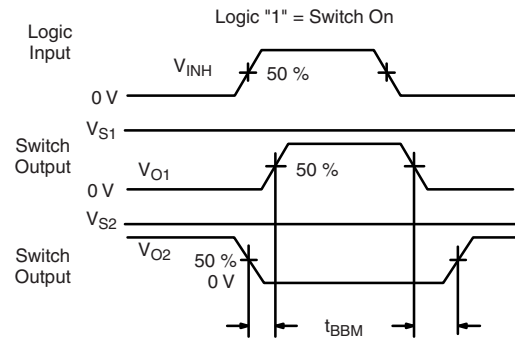
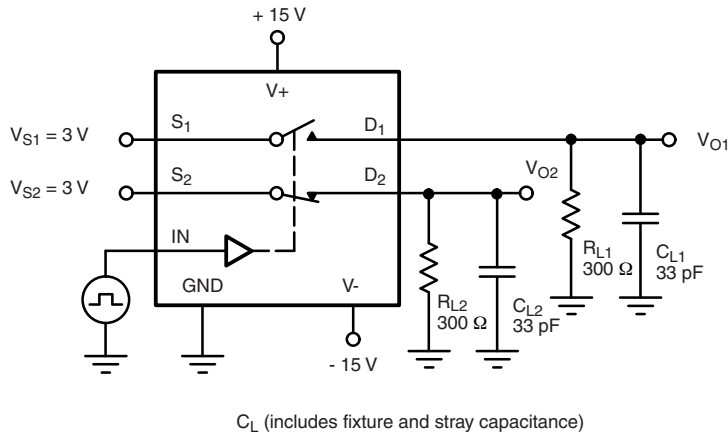


Figure 3. Break-Before-Make SPDT (DG307B)

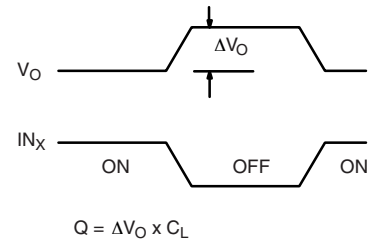
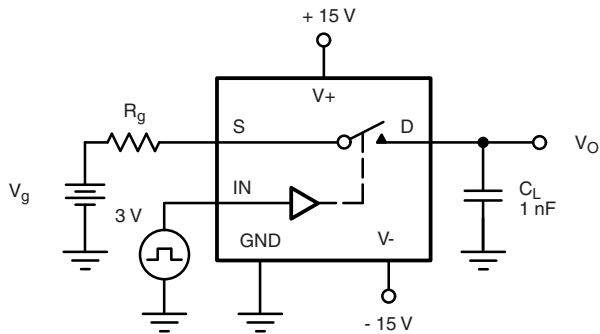


Figure 4. Charge Injection

### 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

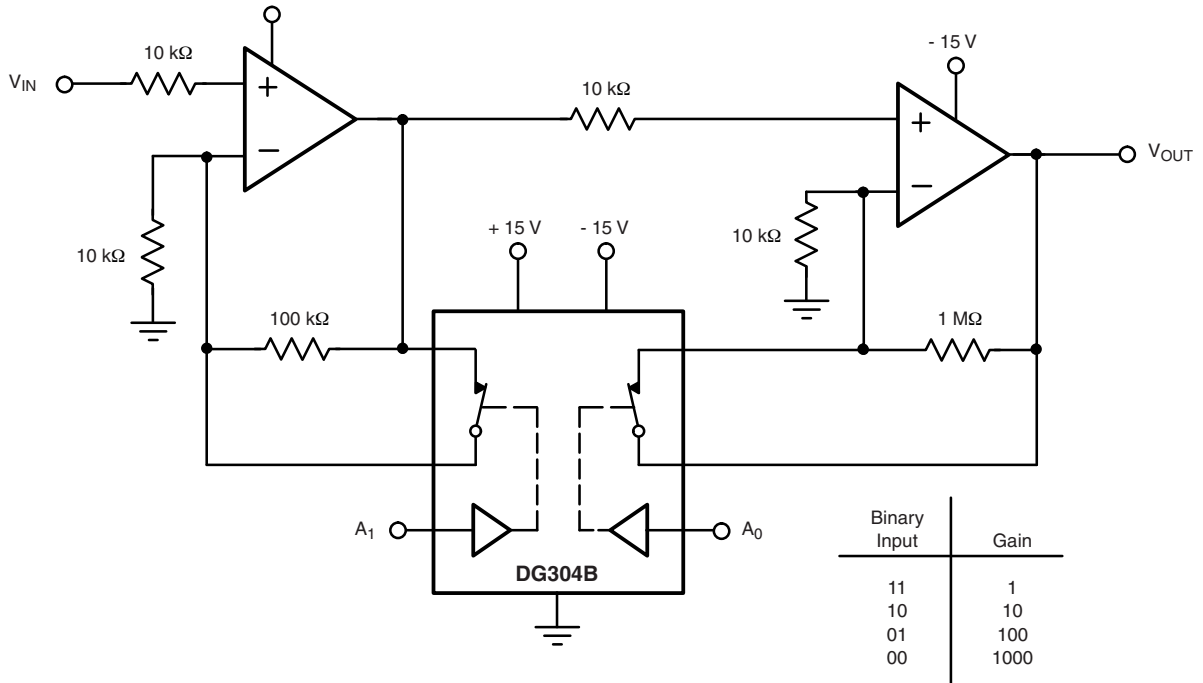


Figure 5. Low Power Binary to 10<sup>n</sup> Gain Low Frequency Amplifier

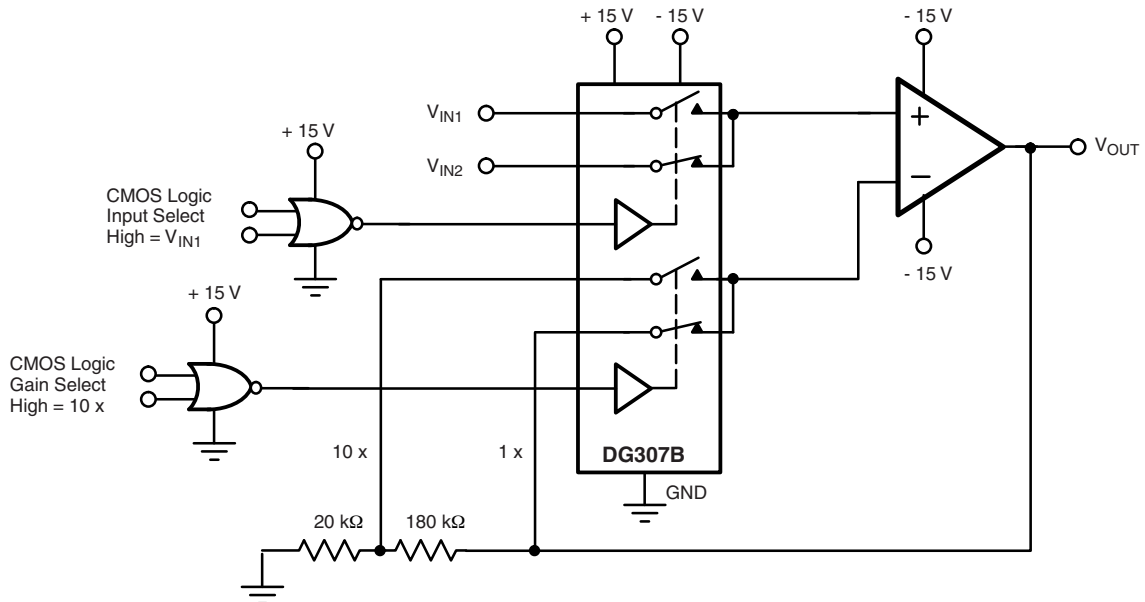
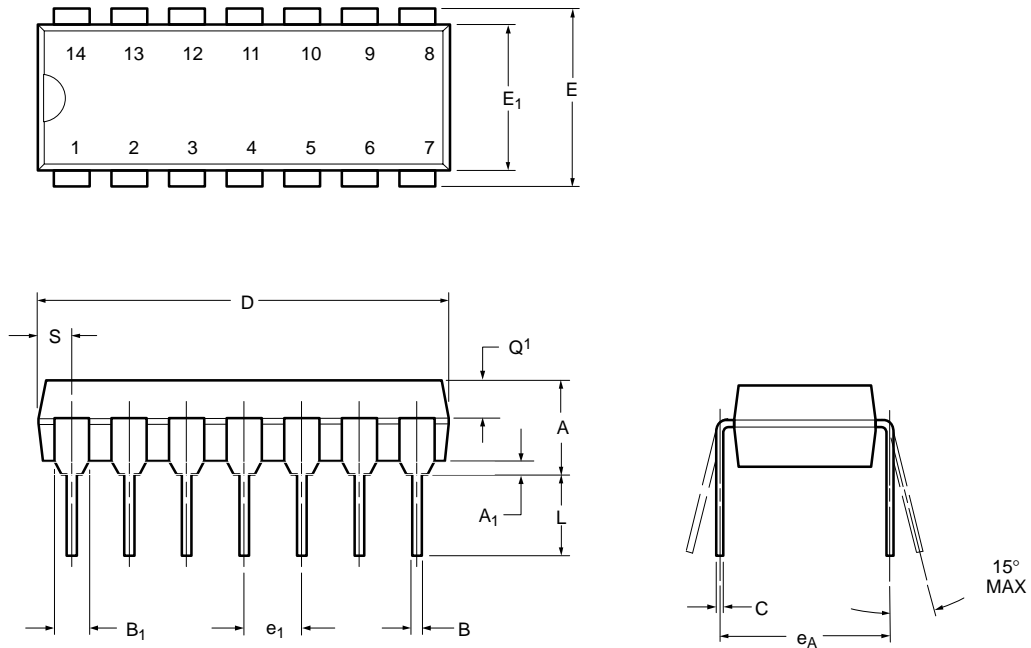


Figure 6. Low Power Instrumentation Amplifier with Digitally Selectable Inputs and Gain

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?71403](http://www.vishay.com/ppg?71403).



**PDIP: 14-LEAD**



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

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





## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**