



## CMOS Analog Switches

### FEATURES

- Analog Signal Range:  $\pm 15\text{ V}$
- Fast Switching— $t_{ON}$ : 150 ns
- Low On-Resistance— $r_{DS(on)}$ : 30  $\Omega$
- Single Supply Operation
- Latch-up Proof
- CMOS Compatible

### BENEFITS

- Full Rail-to-Rail Analog Signal Range
- Low Signal Error
- Low Power Dissipation

### APPLICATIONS

- Low Level Switching Circuits
- Programmable Gain Amplifiers
- Portable and Battery Powered Systems

### DESCRIPTION

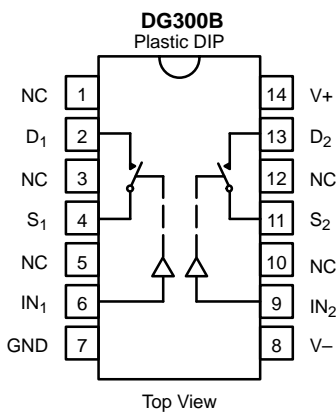
The DG300B-DG303B family of monolithic CMOS switches feature three switch configuration options (SPST, SPDT, and DPST) for precision applications in communications, instrumentation and process control, where low leakage switching combined with low power consumption are required.

Designed on the Vishay Siliconix PLUS-40 CMOS process, these switches are latch-up proof, and are designed to block up to 30 V peak-to-peak when off. An epitaxial layer prevents latchup.

In the on condition the switches conduct equally well in both directions (with no offset voltage) and minimize error conditions with their low on-resistance.

Featuring low power consumption (3.5 mW typ) these switches are ideal for battery powered applications, without sacrificing switching speed. Designed for break-before-make switching action, these devices are CMOS and quasi TTL compatible. Single supply operation is allowed by connecting the V- rail to 0 V.

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



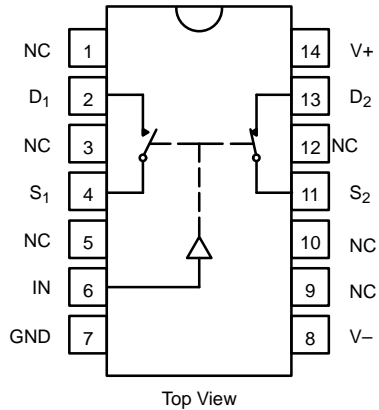
TRUTH TABLE	
Logic	Switch
0	OFF
1	ON

Logic "0"  $\leq 0.8\text{ V}$   
 Logic "1"  $\geq 4\text{ V}$

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

#### DG301B

Plastic DIP

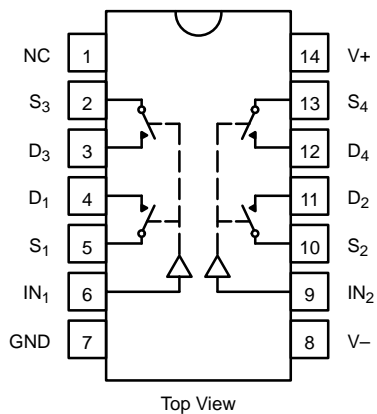


TRUTH TABLE		
Logic	SW <sub>1</sub>	SW <sub>2</sub>
0	OFF	ON
1	ON	OFF

Logic "0" ≤ 0.8 V  
Logic "1" ≥ 4 V

#### DG302B

Plastic DIP

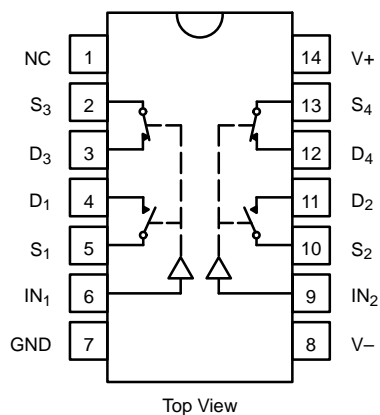


TRUTH TABLE	
Logic	Switch
0	OFF
1	ON

Logic "0" ≤ 0.8 V  
Logic "1" ≥ 4 V

#### DG303B

Plastic DIP and SOIC



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" ≤ 0.8 V  
Logic "1" ≥ 4 V



ORDERING INFORMATION		
Temp Range	Package	Part Number
<b>DG300B</b>		
-40 to 85°C	14-Pin Plastic DIP	DG300BDJ
<b>DG301B</b>		
-40 to 85°C	14-Pin Plastic DIP	DG301BDJ
<b>DG302B</b>		
-40 to 85°C	14-Pin Plastic DIP	DG302BDJ
<b>DG303B</b>		
-40 to 85°C	14-Pin Plastic DIP	DG303BDJ
	14-SOIC	DG303BDY

**ABSOLUTE MAXIMUM RATINGS**

Voltages Referenced to V-  
 V+ ..... 44 V  
 GND ..... 25 V  
 Digital Inputs<sup>NO TAG</sup>, V<sub>S</sub>, V<sub>D</sub> ..... (V-) -2 V to (V+) +2V 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 mA

Storage Temperature ..... -65 to 150°C  
 Power Dissipation<sup>NO TAG</sup>  
 14-Pin Plastic DIP<sup>NO TAG</sup> ..... 470 mW  
 SOIC-14<sup>d</sup> ..... 600 mW

Notes:

- a. Signals on S<sub>X</sub>, D<sub>X</sub>, or I<sub>NX</sub> 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 25°C
- d. Derate 7.6 mW/°C above 75°C

**SCHEMATIC DIAGRAM (TYPICAL CHANNEL)**

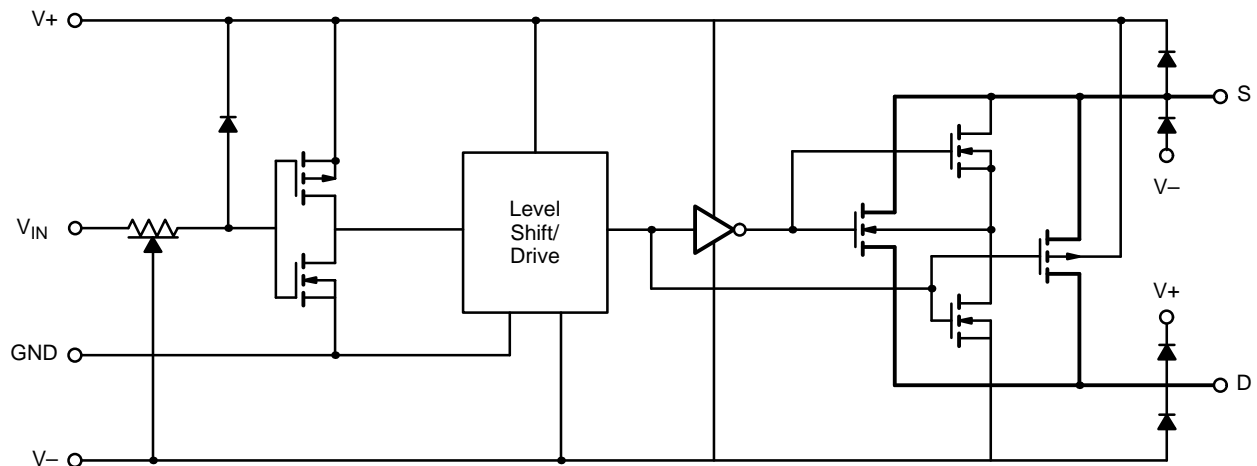


FIGURE 1.

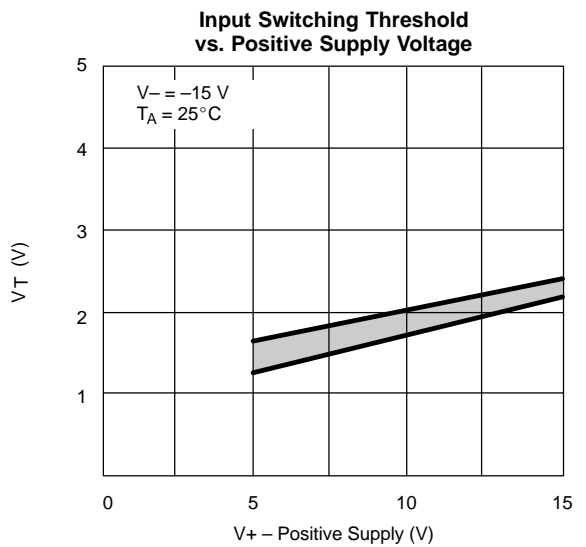
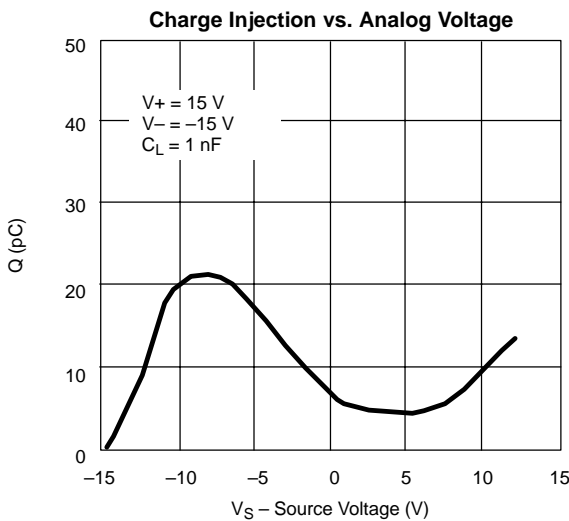
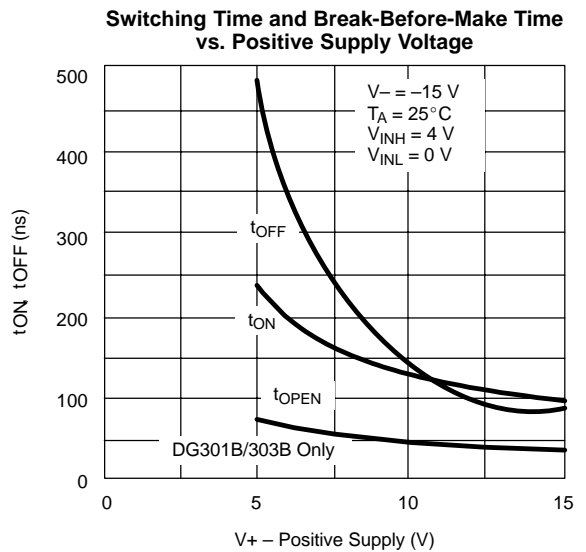
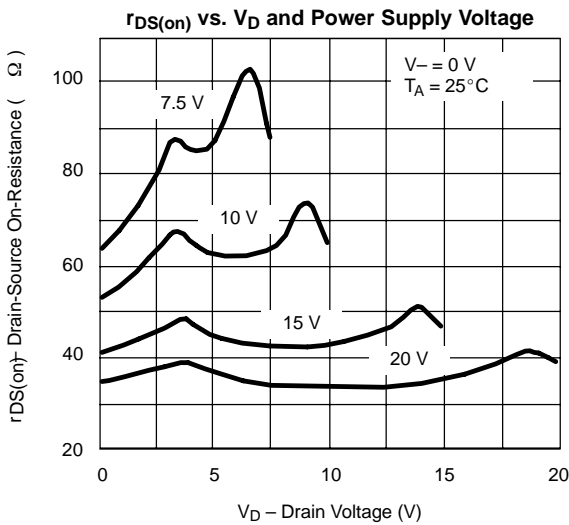
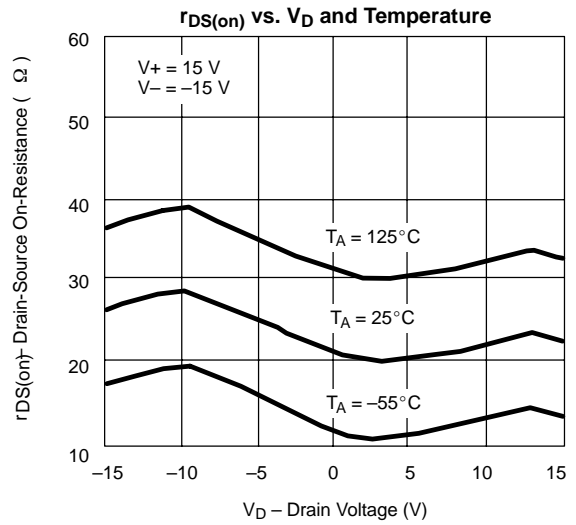
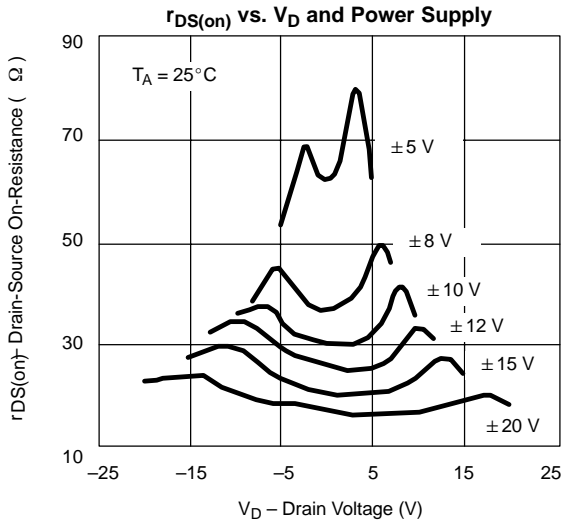
SPECIFICATIONS <sup>a</sup>							
Parameter	Symbol	Test Conditions Unless Specified $V_+ = 15\text{ V}$ , $V_- = -15\text{ V}$ $V_{IN} = 0.8\text{ V}$ or $V_{IN} = 4\text{ V}^f$	Temp <sup>b</sup>	Limits -40 to 85°C			Unit
				Min <sup>d</sup>	Typ <sup>c</sup>	Max <sup>d</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>e</sup>	$V_{ANALOG}$		Full	-15		15	V
Drain-Source On-Resistance	$r_{DS(on)}$	$V_D = \pm 10\text{ V}$ , $I_S = -10\text{ mA}$	Room Full		30	50 75	$\Omega$
Source Off Leakage Current	$I_{S(off)}$	$V_S = \pm 14\text{ V}$ , $V_D = \mp 14\text{ V}$	Room Hot	-5 -100	$\pm 0.1$	5 100	nA
Drain Off Leakage Current	$I_{D(off)}$		Room Hot	-5 -100	$\pm 0.1$	5 100	
Drain On Leakage Current	$I_{D(on)}$		Room Hot	-5 -100	$\pm 0.1$	5 100	
<b>Digital Control</b>							
Input Current with Input Voltage High	$I_{INH}$	$V_{IN} = 5\text{ V}$	Room Full	-1	-0.001		$\mu\text{A}$
		$V_{IN} = 15\text{ V}$	Room Full		0.001	1	
Input Current with Input Voltage Low	$I_{INL}$	$V_{IN} = 0\text{ V}$	Room Full	-1	-0.001		
<b>Dynamic Characteristics</b>							
Turn-On Time	$t_{ON}$	See Figure NO TAG	Room		150		ns
Turn-Off Time	$t_{OFF}$		Room		130		
Break-Before-Make Time	$t_{OPEN}$	DG301B/303B Only Figure NO TAG	Room		50		
Charge Injection	Q	$C_L = 1\text{ nF}$ , $R_{gen} = 0\ \Omega$ $V_{gen} = 0\text{ V}$ , Figure NO TAG	Room		8		pC
Source-Off Capacitance	$C_{S(off)}$	$V_S$ , $V_D = 0\text{ V}$ , $f = 1\text{ MHz}$	Room		14		pF
Drain-Off Capacitance	$C_{D(off)}$		Room		14		
Channel-On Capacitance	$C_{D(on)}$		Room		40		
Input Capacitance	$C_{in}$		$f = 1\text{ MHz}$	Room		6	
Off-Isolation	OIRR	$V_{IN} = 0\text{ V}$ , $R_L = 1\text{ k}\Omega$ $V_S = 1\text{ V}_{rms}$ , $f = 500\text{ kHz}$	Room		62		dB
Crosstalk (Channel-to-Channel)	X_TALK		Room		74		
<b>Power Supplies</b>							
Positive Supply Current	$I_+$	$V_{IN} = 4\text{ V}$ (One Input) All Others = 0 V	Room Full		0.23	1	mA
Negative Supply Current	$I_-$		Room Full	-100	-0.001		
Positive Supply Current	$I_+$	$V_{IN} = 0.8\text{ V}$ (All Inputs)	Room Full		0.001	100	$\mu\text{A}$
Negative Supply Current	$I_-$		Room Full	-100	-0.001		

Notes:

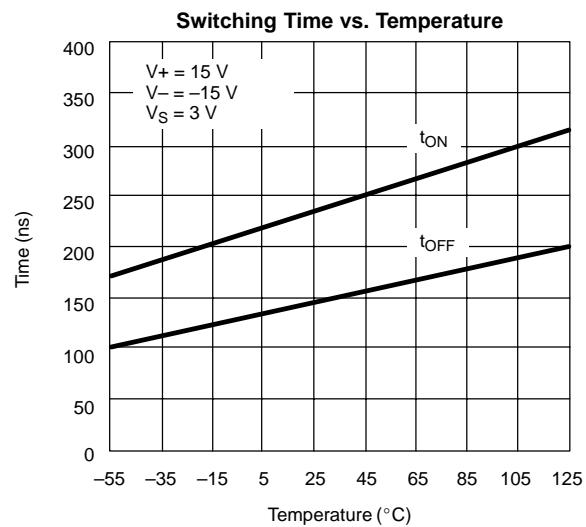
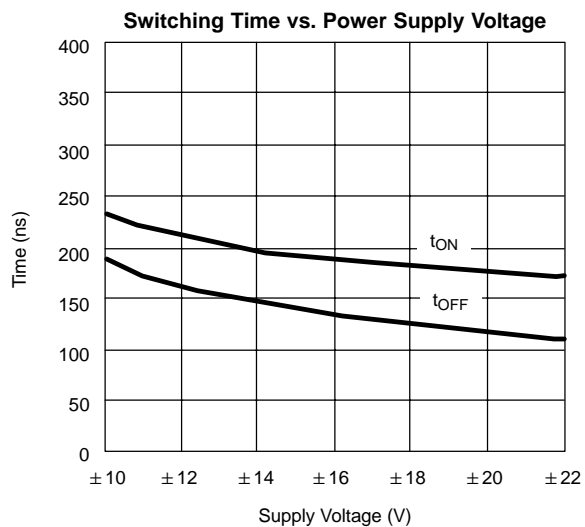
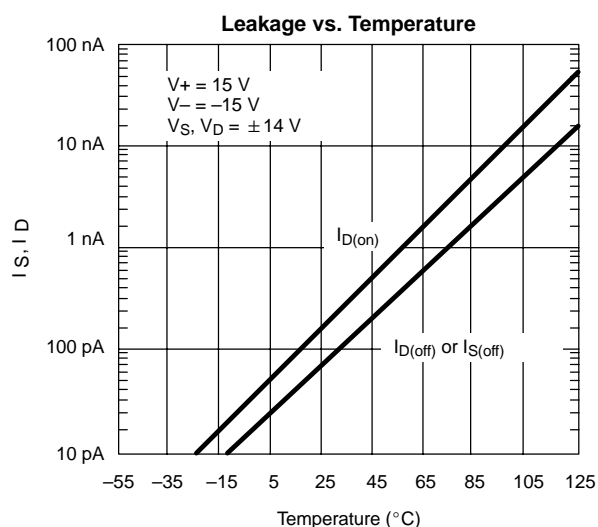
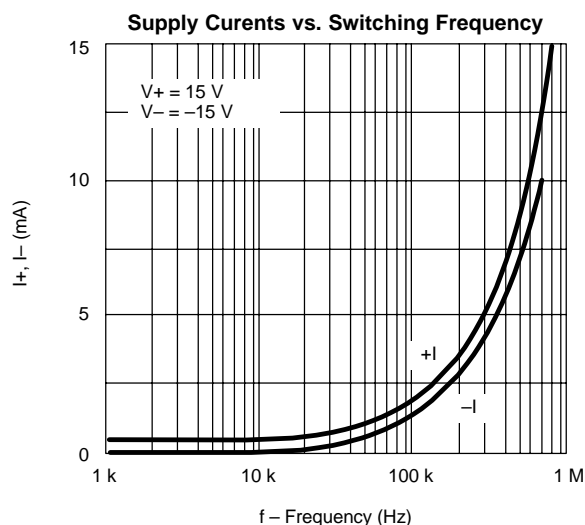
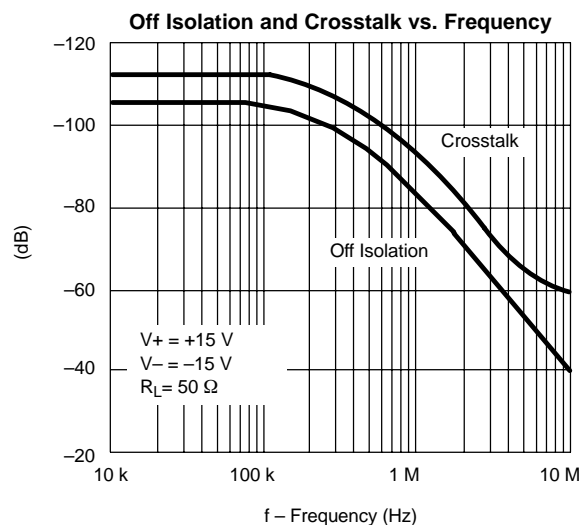
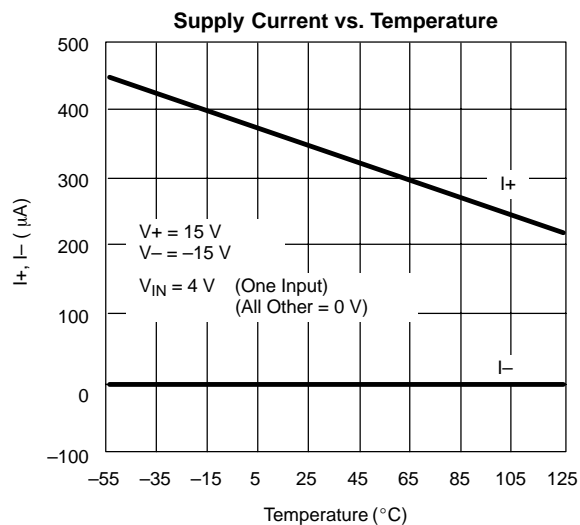
- Refer to PROCESS OPTION FLOWCHART.
- Room = 25°C, Full = as determined by the operating temperature suffix.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum,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



**TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)**



### TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)



### TEST CIRCUITS

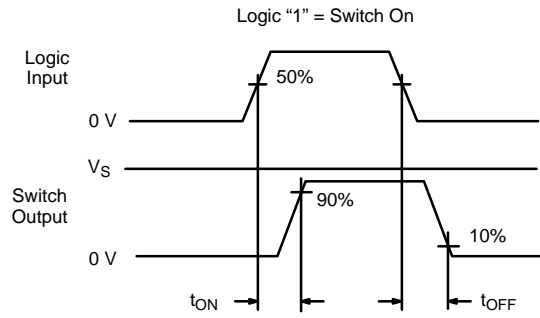
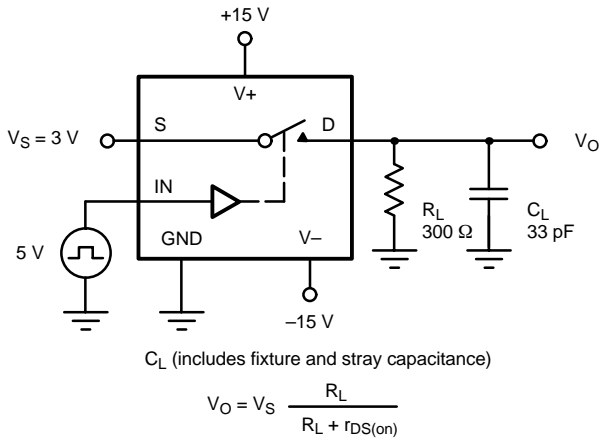


FIGURE 2. Switching Time

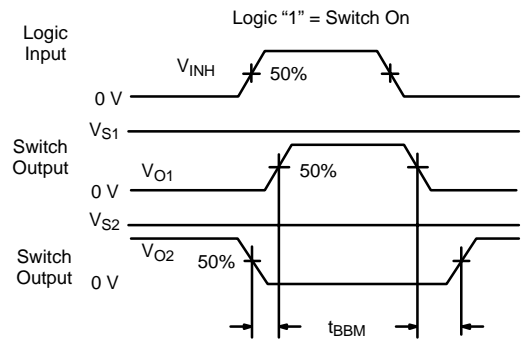
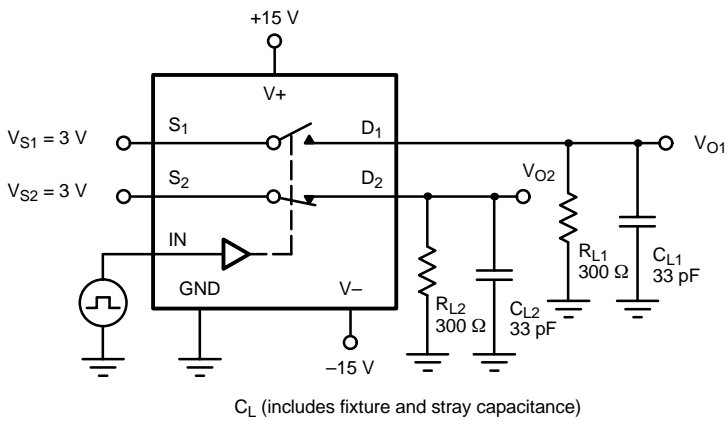


FIGURE 3. Break-Before-Make SPDT (DG301B, DG303B)

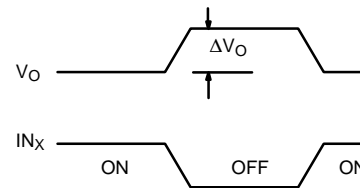
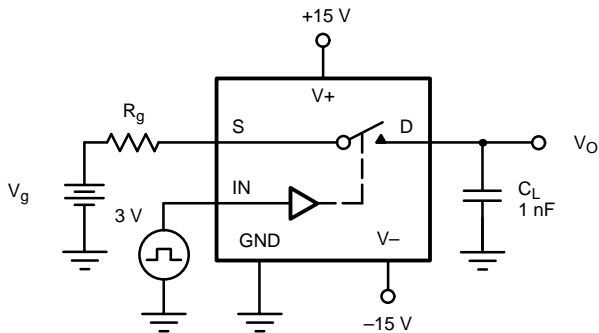


FIGURE 4. Charge Injection

APPLICATION HINTS NO TAG				
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	4/0.8	-15 to 15
20	-20	0	4/0.8	-20 to 20
15	0	0	4/0.8	0 to 15

Note:

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

### APPLICATIONS

The DG300B series of analog switches will switch positive analog signals while using a single positive supply. This facilitates their use in applications where only one supply is available. The trade-offs of using single supplies are:

1) Increased  $r_{DS(on)}$ ; 2) slower switching speed. The analog voltage should not go above or below the supply voltages which in single operation are V+ and 0 V. (See Input Switching Threshold vs. Positive Supply Voltage Curve.)

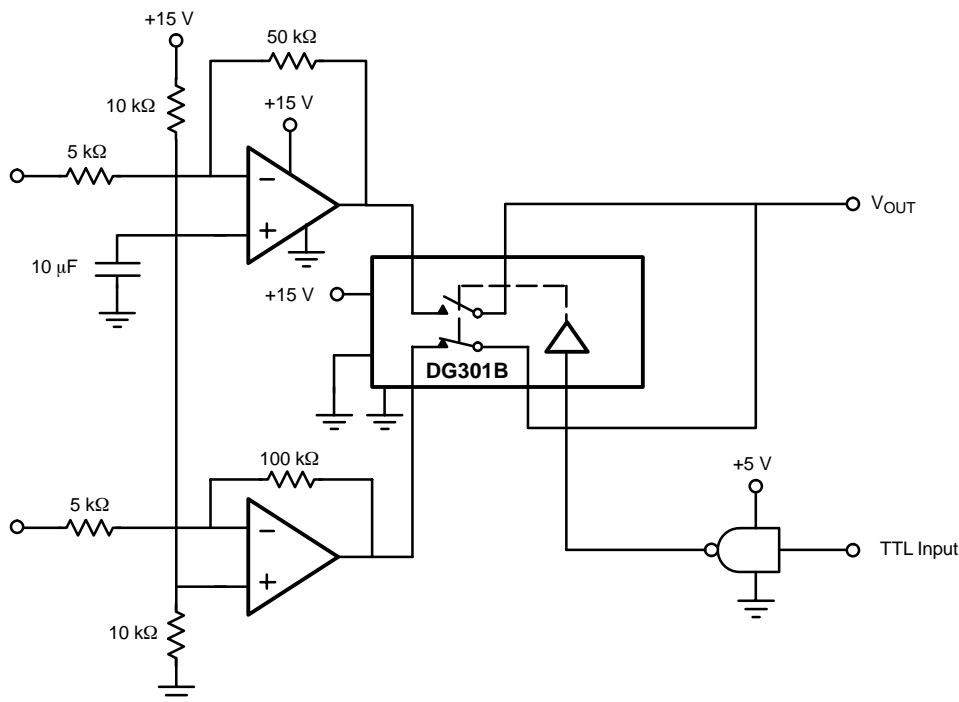
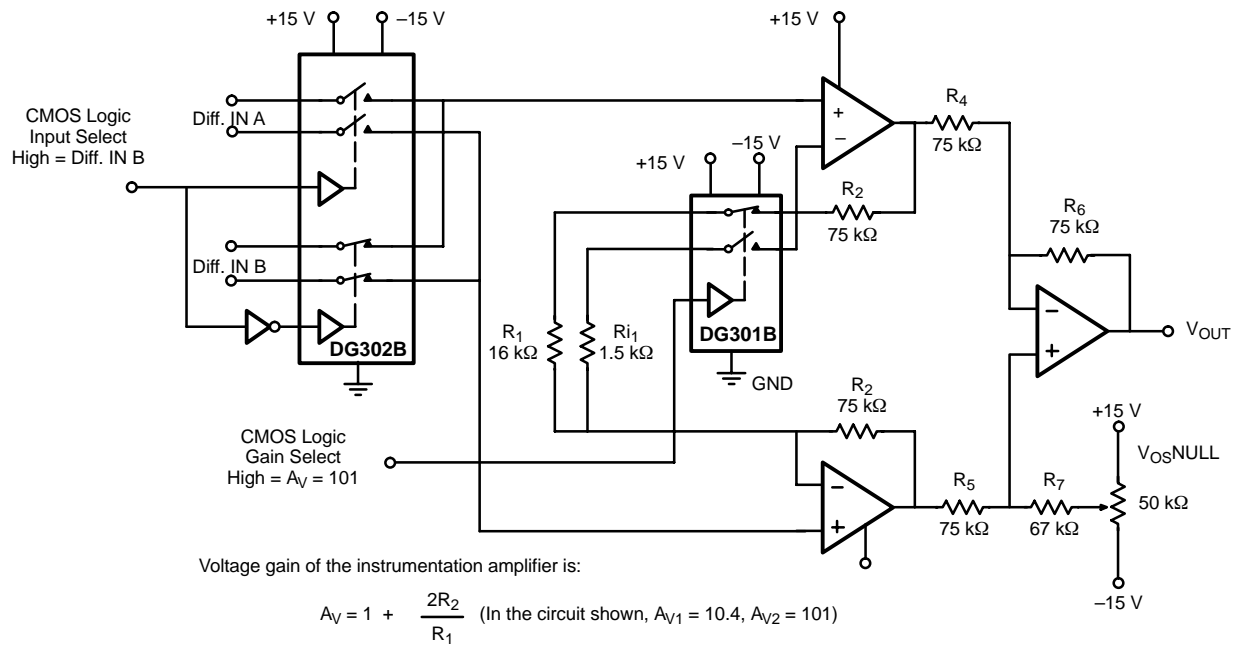


FIGURE 5. Single Supply Op Amp Switching



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



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