

## 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

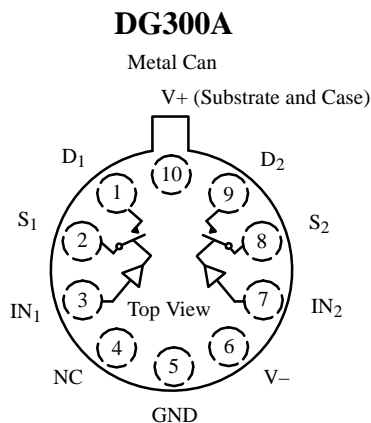
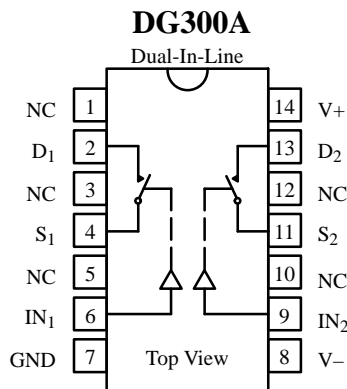
The DG300A-DG303A family of monolithic CMOS switches feature three switch configuration options (SPST, SPDT, and DPST) for precision applications in communications, instrumentation and process control, where low leakage switching combined with low power consumption are required.

Designed on the 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



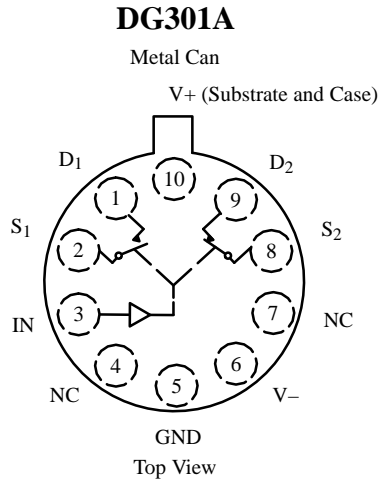
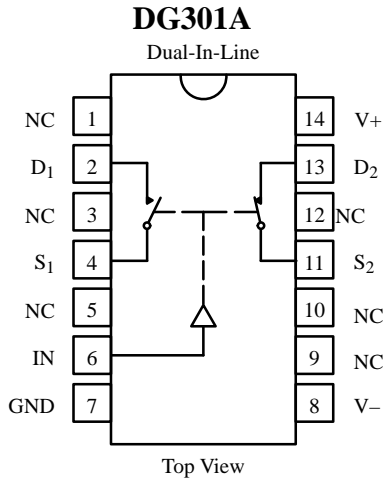
**Truth Table**

Logic	Switch
0	OFF
1	ON

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

Updates to this data sheet may be obtained via facsimile by calling Siliconix FaxBack, 1-408-970-5600. Please request FaxBack document #70044.

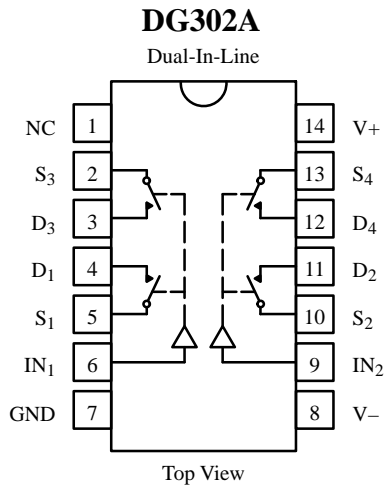
## Functional Block Diagram and Pin Configuration (Cont'd)



**Truth Table**

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

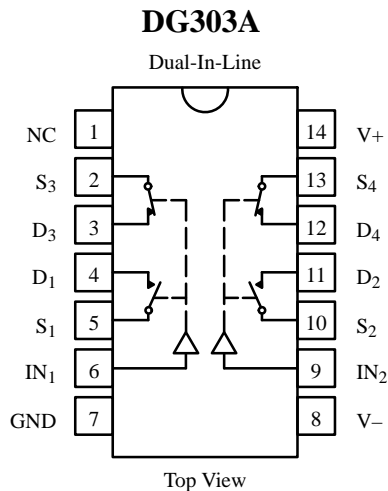
Logic "0"  $\leq 0.8$  V  
Logic "1"  $\geq 4$  V



**Truth Table**

Logic	Switch
0	OFF
1	ON

Logic "0"  $\leq 0.8$  V  
Logic "1"  $\geq 4$  V



**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"  $\leq 0.8$  V  
Logic "1"  $\geq 4$  V

**Ordering Information**

Temp Range	Package	Part Number
<b>DG300A</b>		
0 to 70°C	14-Pin Plastic DIP	DG300ACJ
-25 to 85°C	14-Pin CerDIP	DG300ABK
	10-Pin Metal Can	DG300ABA
-55 to 125°C	14-Pin CerDIP	DG300AAK
		DG300AAK/883
		JM38510/11601BCA
	14-Pin Sidebrazed	JM38510/11601BCC
	10-Pin Metal Can	DG300AAA/883
		JM38510/11601BIA
<b>DG301A</b>		
0 to 70°C	14-Pin Plastic DIP	DG301ACJ
-25 to 85°C	14-Pin CerDIP	DG301ABK
	10-Pin Metal Can	DG301ABA
-55 to 125°C	14-Pin CerDIP	DG301AAK/883
		JM38510/11602BCA
		JM38510/11602BCC
	10-Pin Metal Can	DG301AAA
		DG301AAA/883
		JM38510/11602BIA
<b>DG302A</b>		
0 to 70°C	14-Pin Plastic DIP	DG302ACJ
-55 to 125°C	14-Pin CerDIP	DG302AAK
		DG302AAK/883
		JM38510/11603BCA
14-Pin Sidebrazed	JM38510/11603BCC	
<b>DG303A</b>		
0 to 70°C	14-Pin Plastic DIP	DG303ACJ
-25 to 85°C	14-Pin CerDIP	DG303ABK
-45 to 85°C	14-SOIC	DG303ADY
-55 to 125°C	14-Pin CerDIP	DG303AAK
		DG303AAK/883
		JM38510/11604BCA
	14-Pin Sidebrazed	JM38510/11604BCC

## Absolute Maximum Ratings

Voltages Referenced to V-

V+ ..... 44 V

GND ..... 25 V

Digital Inputs<sup>a</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 (A & B Suffix) ..... -65 to 150°C

(C Suffix) ..... -65 to 125°C

Power Dissipation<sup>b</sup>

14-Pin Plastic DIP<sup>c</sup> ..... 470 mW

14-Pin CerDIP<sup>d</sup> ..... 825 mW

10-Pin Metal Can<sup>e</sup> ..... 450 mW

Notes:

a. Signals on S<sub>X</sub>, D<sub>X</sub>, or IN<sub>X</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 11 mW/°C above 75°C

e. Derate 6 mW/°C above 75°C

## Schematic Diagram (Typical Channel)

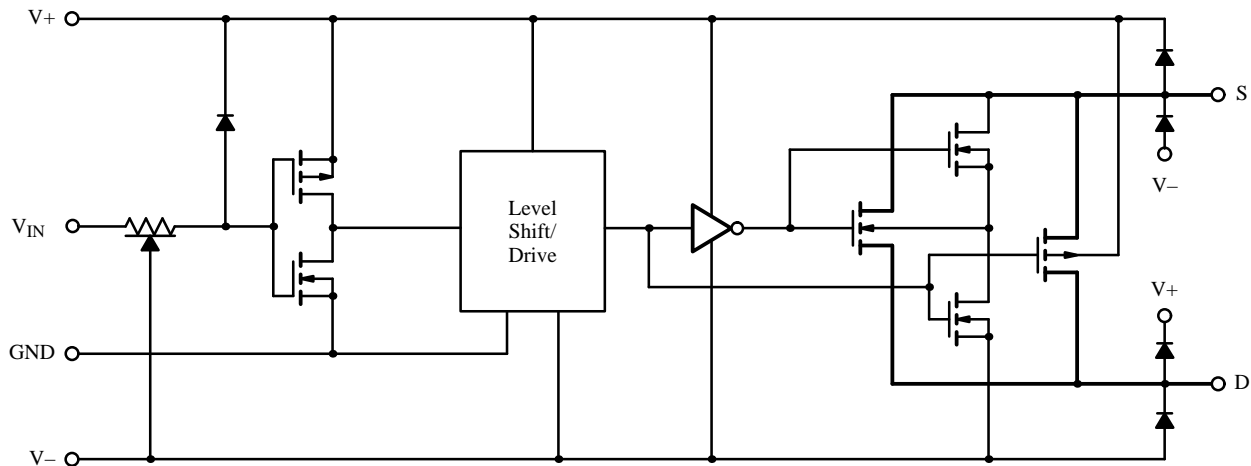


Figure 1.

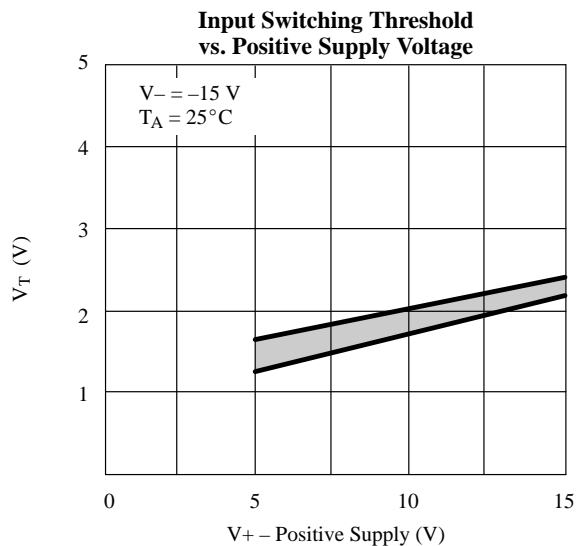
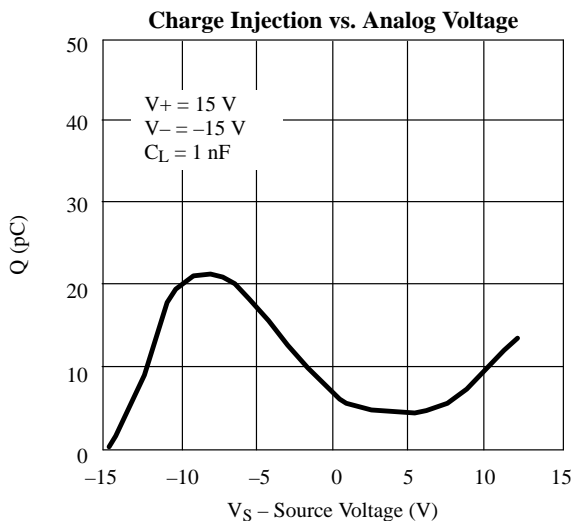
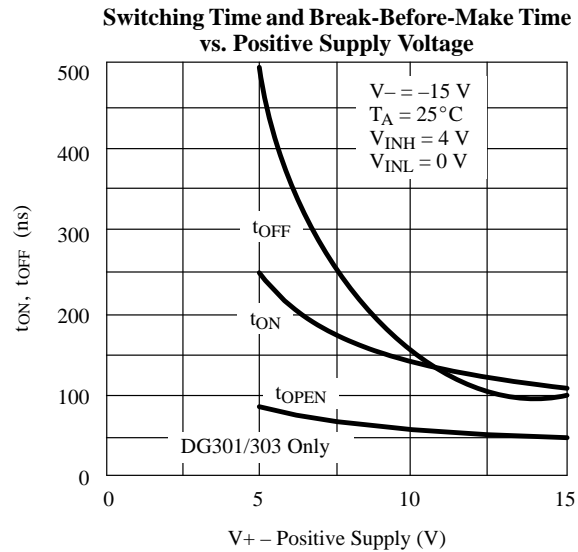
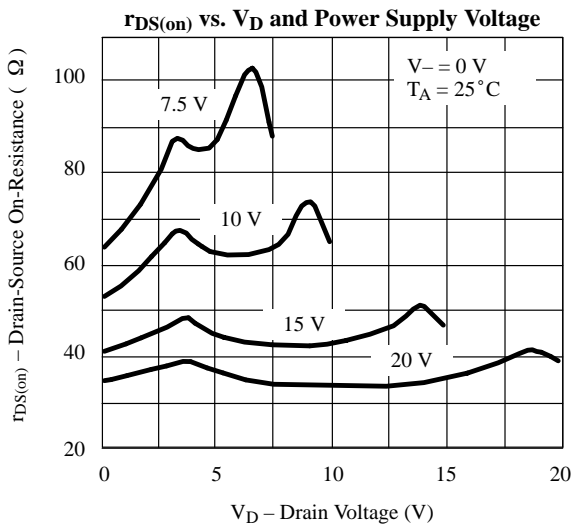
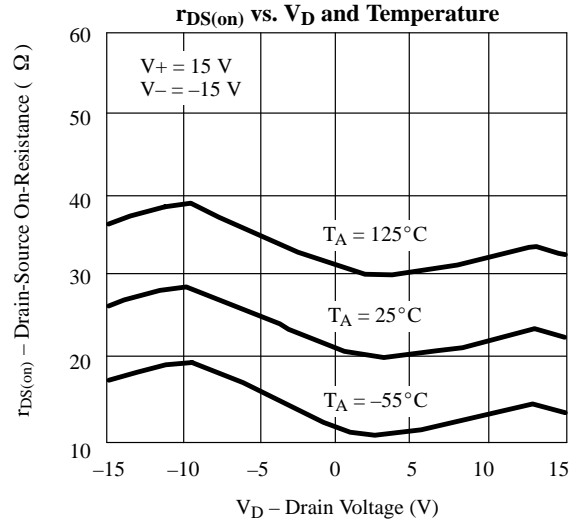
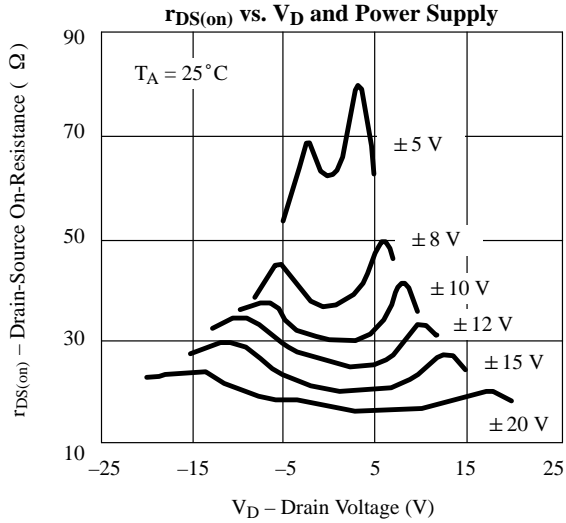
## Specifications<sup>a</sup>

Parameter	Symbol	Conditions Unless Otherwise 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>	Typ <sup>c</sup>	A Suffix -55 to 125°C		B/C Suffix		Unit
					Min <sup>d</sup>	Max <sup>d</sup>	Min <sup>d</sup>	Max <sup>d</sup>	
<b>Analog Switch</b>									
Analog Signal Range <sup>e</sup>	$V_{ANALOG}$		Full		-15	15	-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		50 75	$\Omega$
Source Off Leakage Current	$I_{S(off)}$	$V_S = \pm 14\text{ V}$ , $V_D = \mp 14\text{ V}$	Room Hot	$\pm 0.1$	-1 -100	1 100	-5 -100	5 100	nA
Drain Off Leakage Current	$I_{D(off)}$		Room Hot	$\pm 0.1$	-1 -100	1 100	-5 -100	5 100	
Drain On Leakage Current	$I_{D(on)}$	$V_D = V_S = \pm 14\text{ V}$	Room Hot	$\pm 0.1$	-1 -100	1 100	-5 -100	5 100	
<b>Digital Control</b>									
Input Current with Input Voltage High	$I_{INH}$	$V_{IN} = 5\text{ V}$	Room Full	-0.001	-1 -1		-1		$\mu\text{A}$
		$V_{IN} = 15\text{ V}$	Room Full	0.001		1 1		1	
Input Current with Input Voltage Low	$I_{INL}$	$V_{IN} = 0\text{ V}$	Room Full	-0.001	-1 -1		-1		
<b>Dynamic Characteristics</b>									
Turn-On Time	$t_{ON}$	See Figure 2	Room	150		300			ns
Turn-Off Time	$t_{OFF}$		Room	130		250			
Break-Before-Make Time	$t_{OPEN}$	DG301A/303A Only Figure 3	Room	50					
Charge Injection	Q	$C_L = 1\text{ nF}$ , $R_{gen} = 0\ \Omega$ $V_{gen} = 0\text{ V}$ , Figure 4	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	$C_{in}$	$f = 1\text{ MHz}$	$V_{IN} = 0\text{ V}$	Room	6				
			$V_{IN} = 15\text{ V}$	Room	7				
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		0.5 1		1	mA
Negative Supply Current	$I_-$		Room Full	-0.001	-10 -100		-100		$\mu\text{A}$
Positive Supply Current	$I_+$	$V_{IN} = 0.8\text{ V}$ (All Inputs)	Room Full	0.001		10 100		100	
Negative Supply Current	$I_-$		Room Full	-0.001	-10 -100		-100		

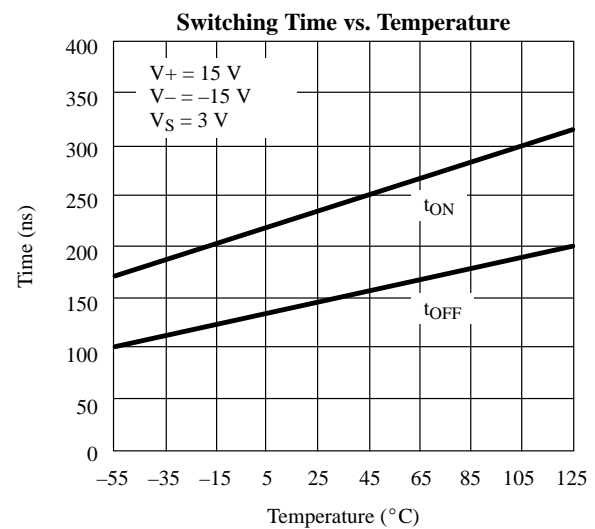
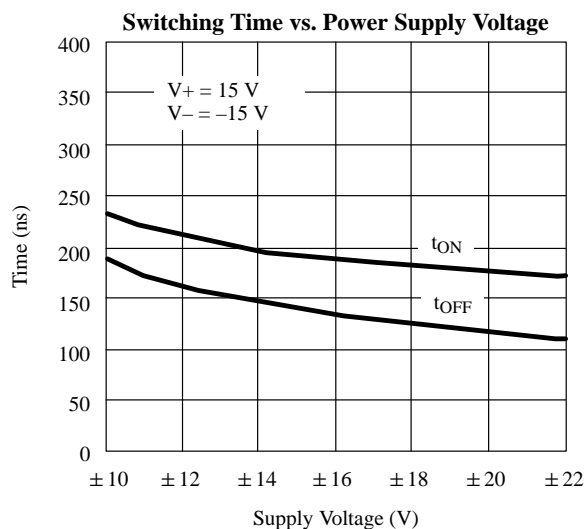
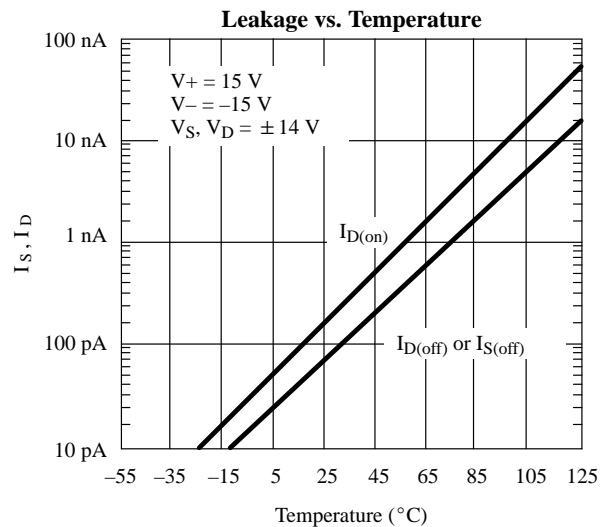
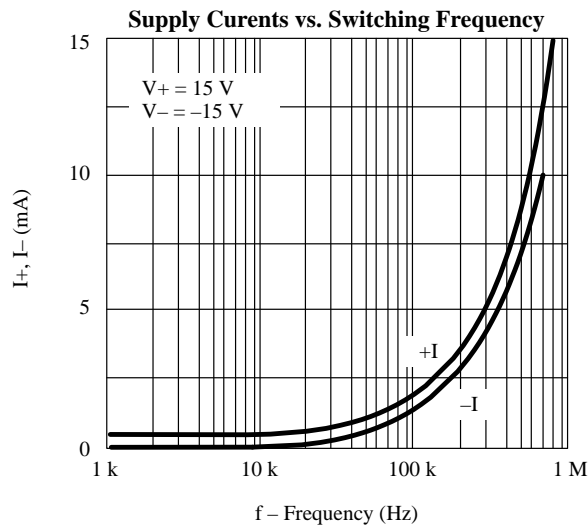
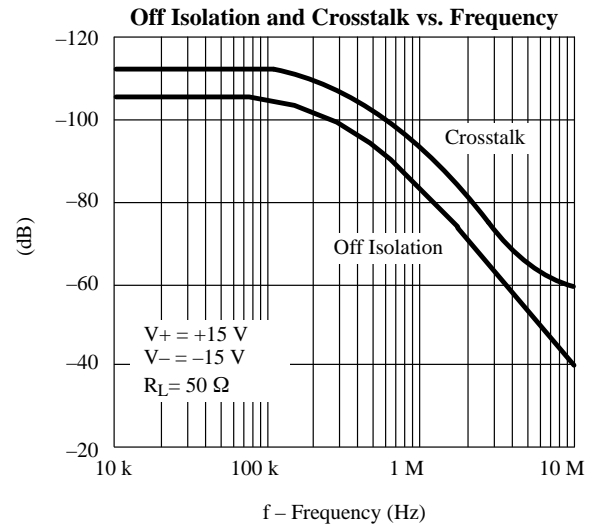
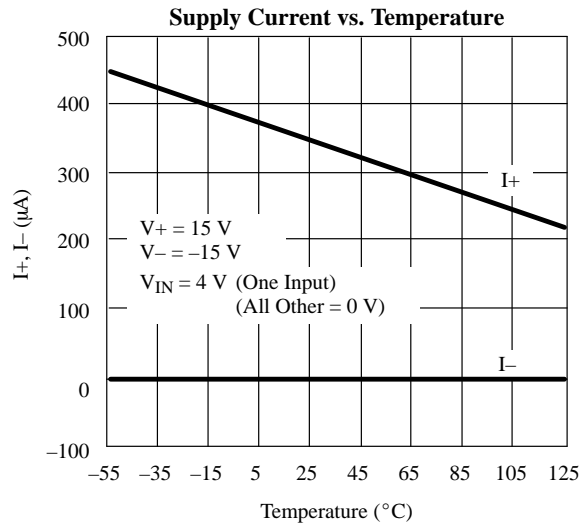
Notes:

- 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.

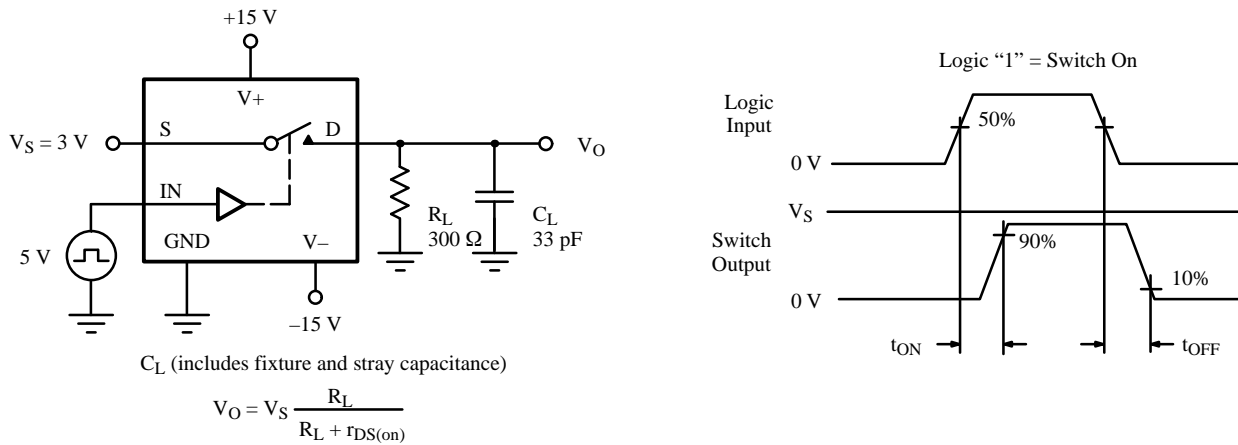
## Typical Characteristics



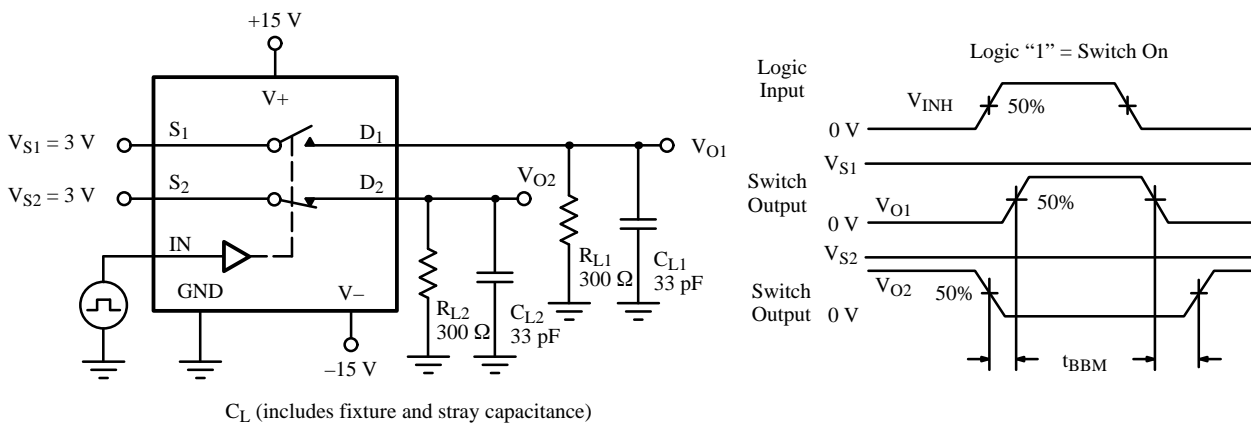
## Typical Characteristics (Cont'd)



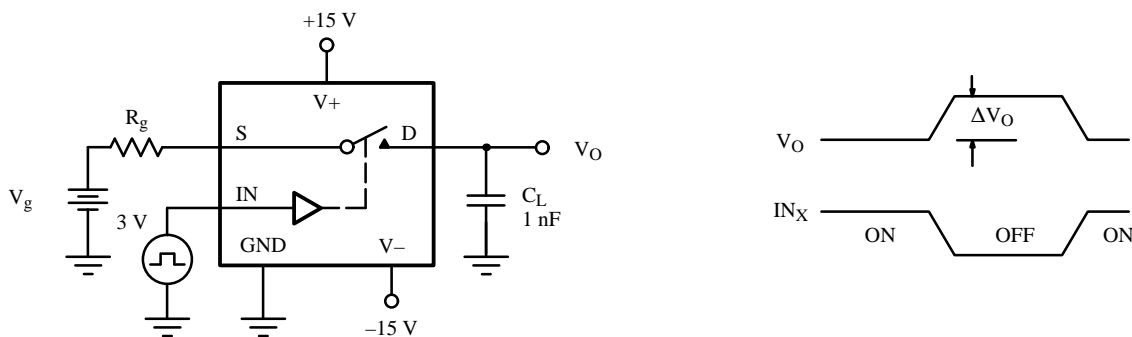
## Test Circuits



**Figure 2.** Switching Time



**Figure 3.** Break-Before-Make SPDT (DG301A, DG303A)



**Figure 4.** Charge Injection



## Application 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	4/0.8	-15 to 15
20	-20	0	4/0.8	-20 to 20
15	0	0	4/0.8	0 to 15

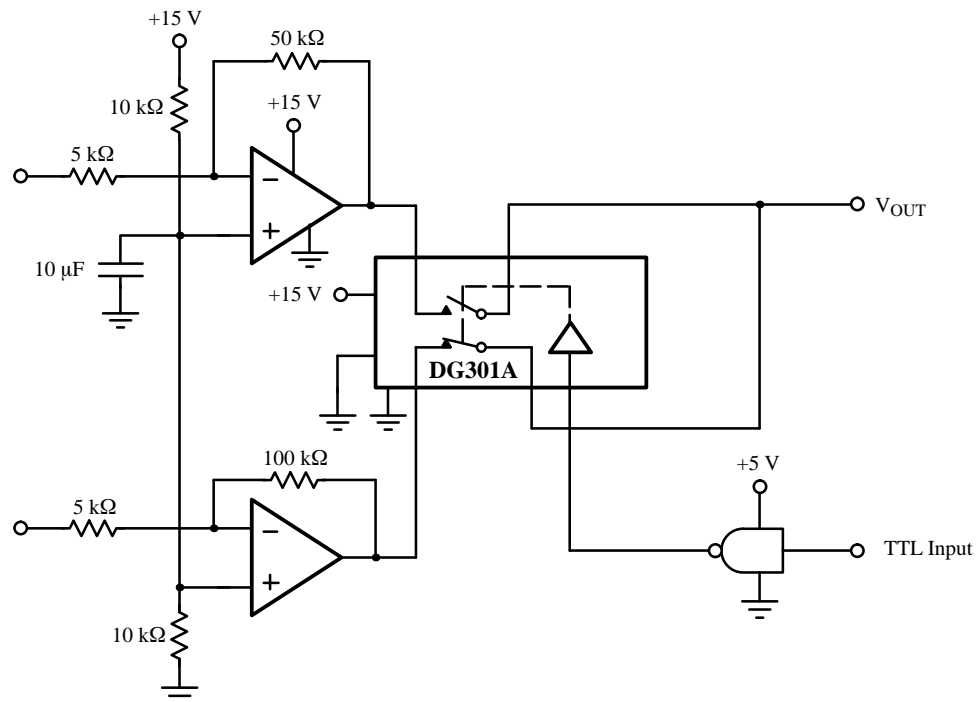
Note:

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

## Applications

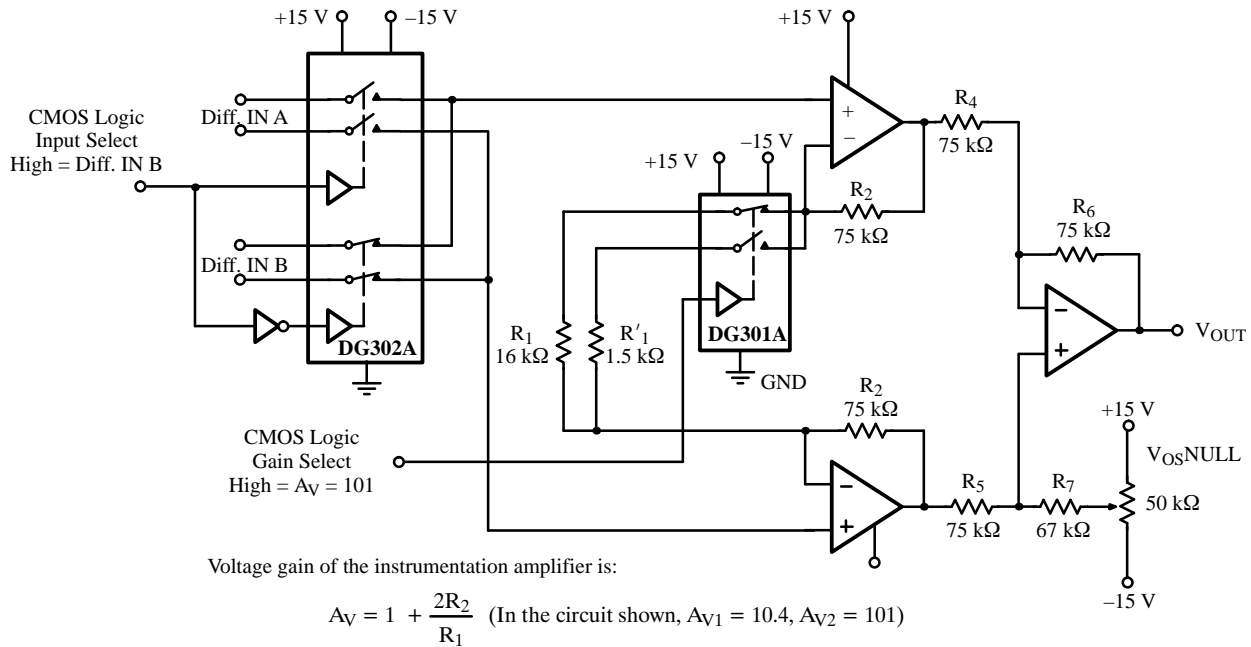
The DG300A series of analog switches will switch positive analog signals while using a single positive supply. This facilitates their use in applications where only one supply is available. The trade-offs of using single supplies are:

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

## Applications (Cont'd)



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