

## CMOS Analog Switches

### DESCRIPTION

The 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.

### FEATURES

- Analog signal range:  $\pm 15$  V
- Fast switching -  $t_{on}$ : 150 ns
- Low on-resistance -  $R_{DS(on)}$ : 30  $\Omega$
- Single supply operation
- Latch-up proof
- CMOS compatible
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS\***  
Available

### Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

### APPLICATIONS

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

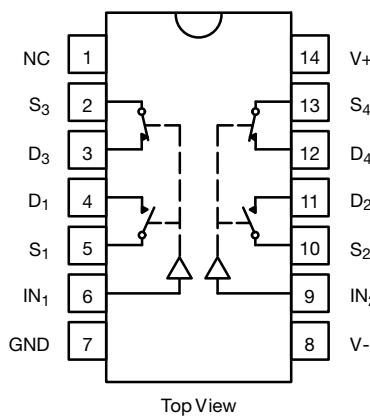
### BENEFITS

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

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG303B

SOIC



Top View

### 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

### Note

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

**ORDERING INFORMATION**

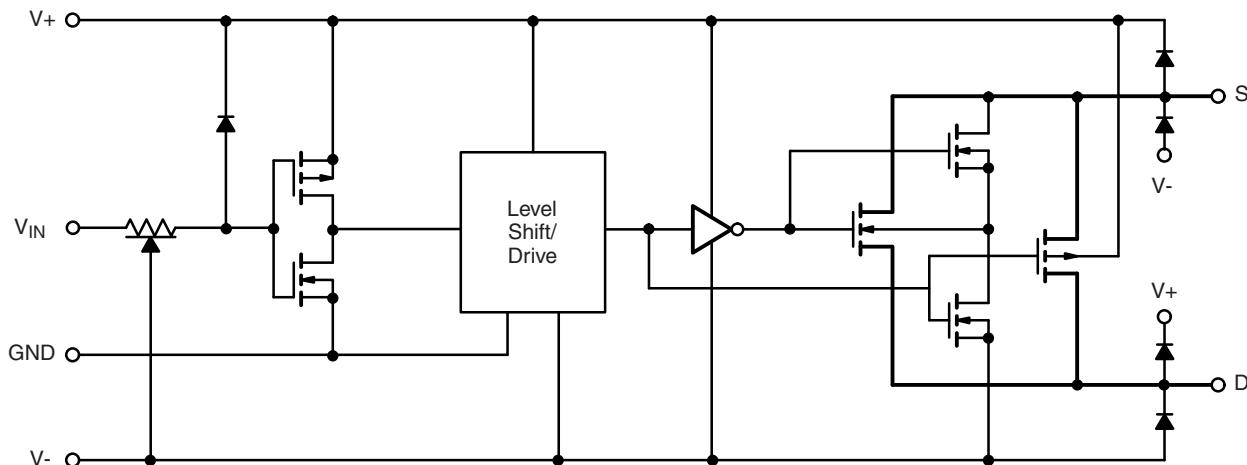
TEMP. RANGE	STANDARD PACKAGE	PART NUMBER
-40 °C to +85 °C	14-SOIC	DG303BDY-E3

**ABSOLUTE MAXIMUM RATINGS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

PARAMETER	LIMIT	UNIT
Voltages referenced V+ to V-	44	V
GND	25	
Digital inputs <sup>a</sup> , $V_S$ , $V_D$	(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 (package) <sup>b</sup>	600	mW
SOIC-14 <sup>c</sup>		

**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 6.5 mW/°C above 25 °C
- d. Derate 7.6 mW/°C above 75 °C

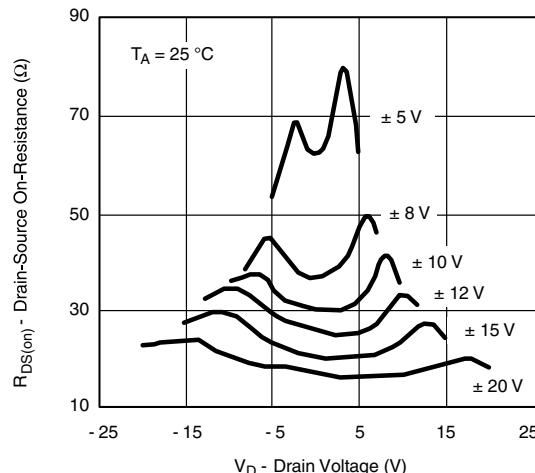
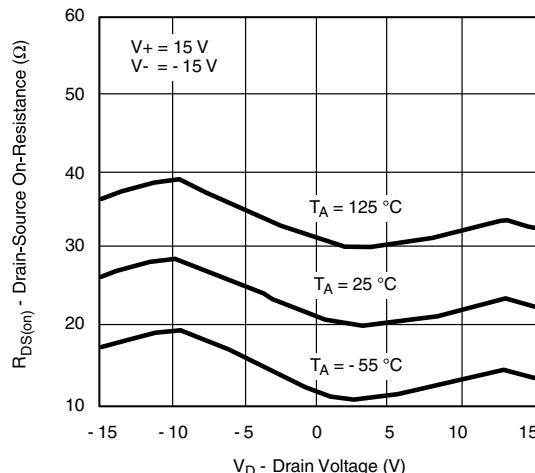
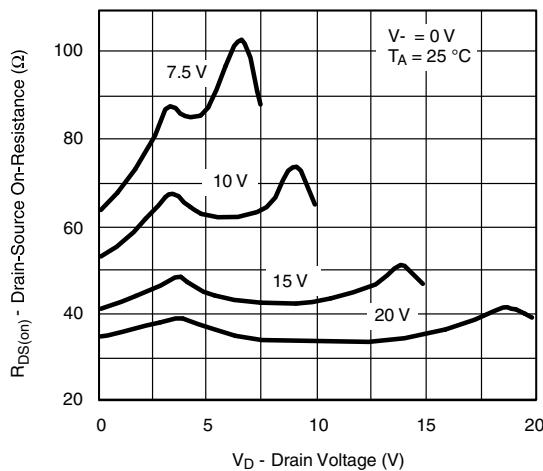
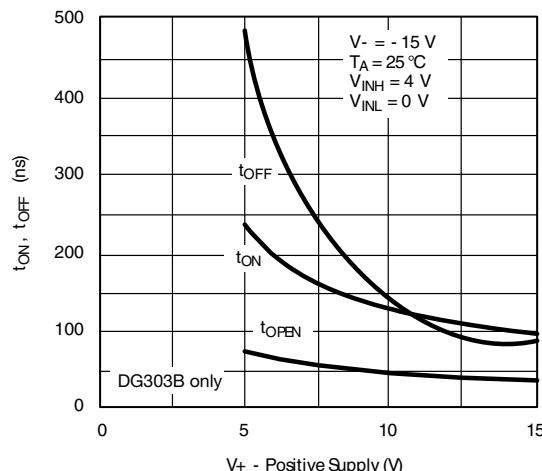
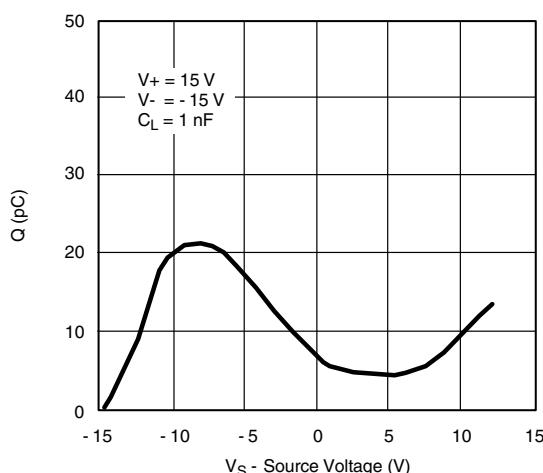
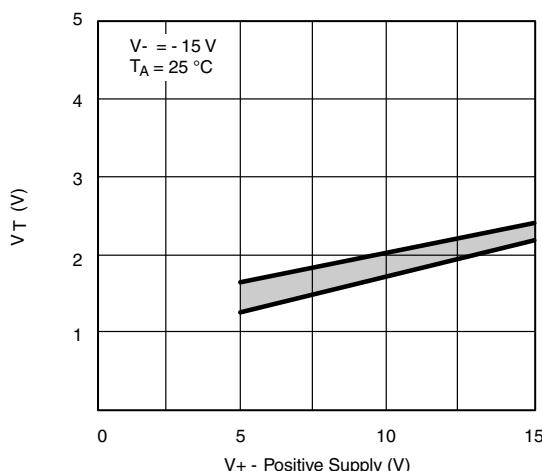
**SCHEMATIC DIAGRAM** (typical channel)

**Fig. 1**

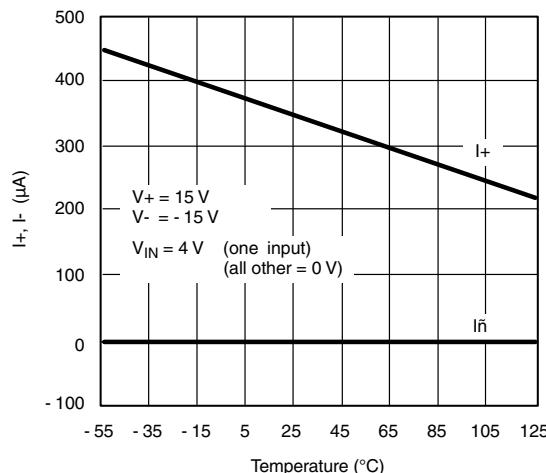
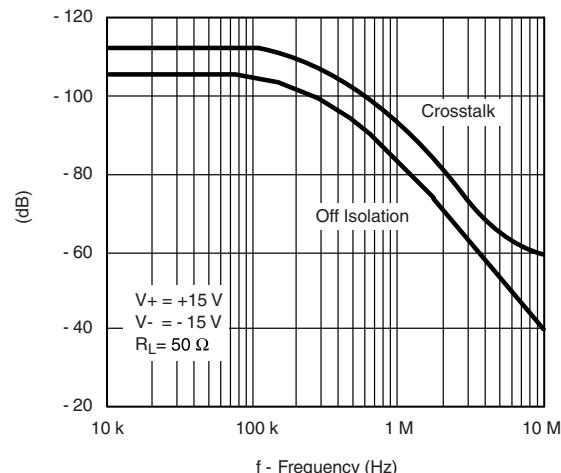
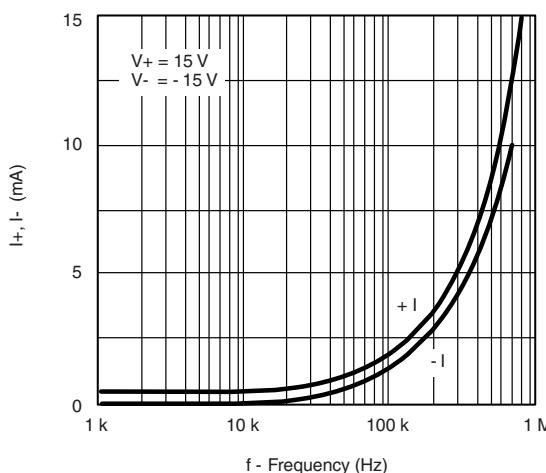
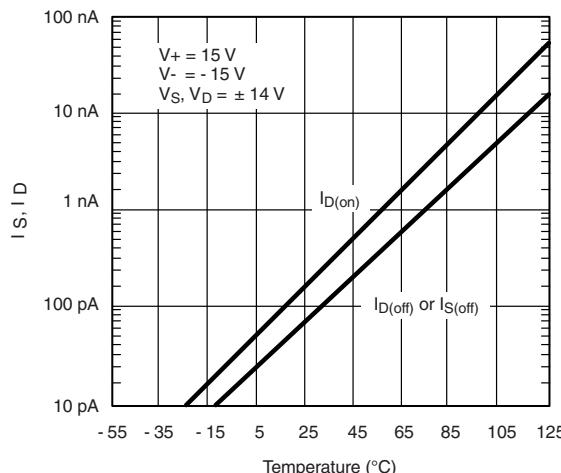
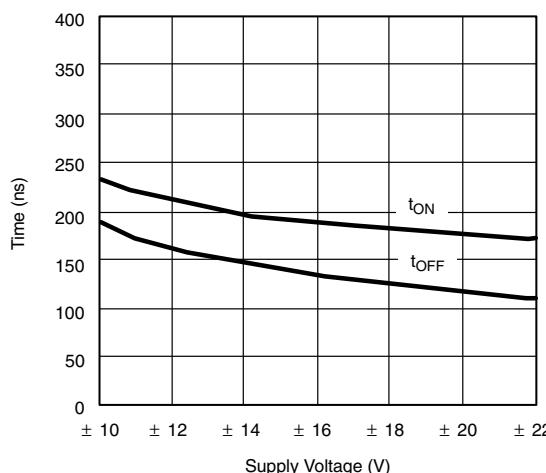
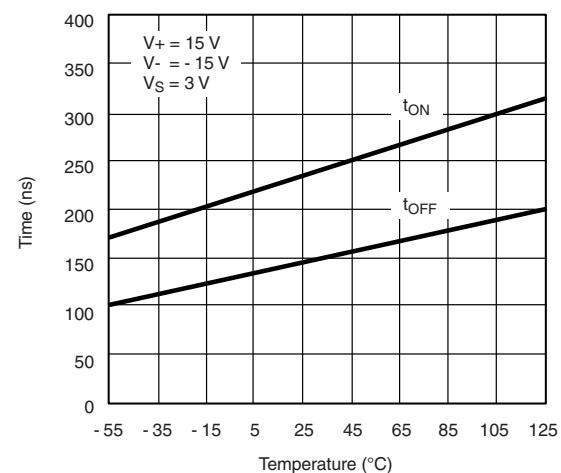
SPECIFICATIONS <sup>a</sup>							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS OTHERWISE SPECIFIED $V_+ = 15 \text{ V}$ , $V_- = -15 \text{ V}$ $V_{IN} = 0.8 \text{ V}$ OR $V_{IN} = 4 \text{ V}$ <sup>f</sup>	TEMP.B	LIMITS -40 °C TO +85 °C			UNIT
				MIN. <sup>d</sup>	TYP. <sup>c</sup>	MAX. <sup>d</sup>	
<b>Analog Switch</b>							
Analog signal range <sup>e</sup>	$V_{ANALOG}$		Full	-15	-	15	V
Drain-source on-resistance	$R_{DS(on)}$	$V_D = \pm 10 \text{ V}$ , $I_S = -10 \text{ mA}$	Room	-	30	50	$\Omega$
Source off leakage current	$I_{S(off)}$		Full	-	-	75	
Drain off leakage current	$I_{D(off)}$	$V_S = \pm 14 \text{ V}$ , $V_D = \pm 14 \text{ V}$	Room	-5	$\pm 0.1$	5	$n\text{A}$
Drain on leakage current	$I_{D(on)}$		Hot	-100	-	100	
Input current with input voltage high	$I_{INH}$	$V_{IN} = 5 \text{ V}$	Room	-5	$\pm 0.1$	5	$\mu\text{A}$
Input current with input voltage low	$I_{INL}$		Hot	-100	-	100	
<b>Digital Control</b>							
Input current with input voltage high		$V_{IN} = 15 \text{ V}$	Room	-1	-0.001	-	$\mu\text{A}$
Input current with input voltage low			Full	-	-	-	
Input capacitance	$C_{IN}$	$f = 1 \text{ MHz}$	Room	-	0.001	1	
Input capacitance			Full	-	-	-	
<b>Dynamic Characteristics</b>							
Turn-on time	$t_{on}$	See Fig. 2	Room	-	150	-	ns
Turn-off time	$t_{off}$		Room	-	130	-	
Break-before-make time	$t_{OPEN}$	DG303B only, Fig. 3	Room	-	50	-	
Charge injection	$Q$	$C_L = 1 \text{ nF}$ , $R_{gen} = 0 \Omega$ , $V_{gen} = 0 \text{ V}$ , Fig. 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	pF
Input capacitance			$V_{IN} = 15 \text{ V}$	Room	-	7	
Off isolation	$OIRR$	$V_{IN} = 0 \text{ V}$ , $R_L = 1 \text{ k}\Omega$ , $V_S = 1 \text{ V}_{\text{RMS}}$ , $f = 500 \text{ kHz}$	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	-	0.23	1	mA
Negative supply current	$I_-$		Full	-	-	-	
Positive supply current	$I_+$	$V_{IN} = 0.8 \text{ V}$ (all inputs)	Room	-100	-0.001	-	$\mu\text{A}$
Negative supply current	$I_-$		Full	-	-	-	
Positive supply current			Room	-100	-0.001	-	
Negative supply current			Full	-	-	-	

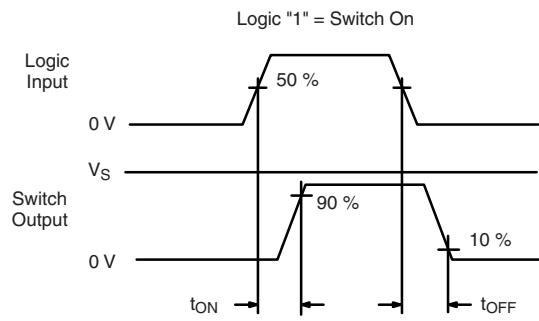
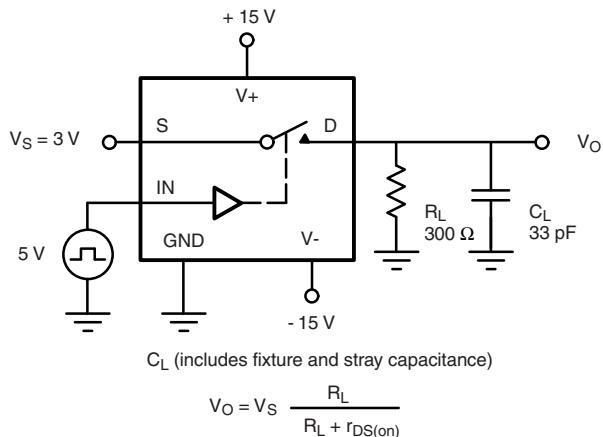
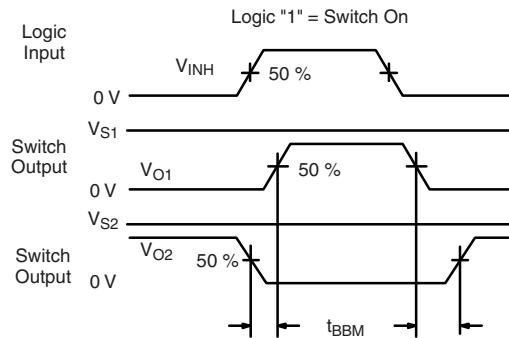
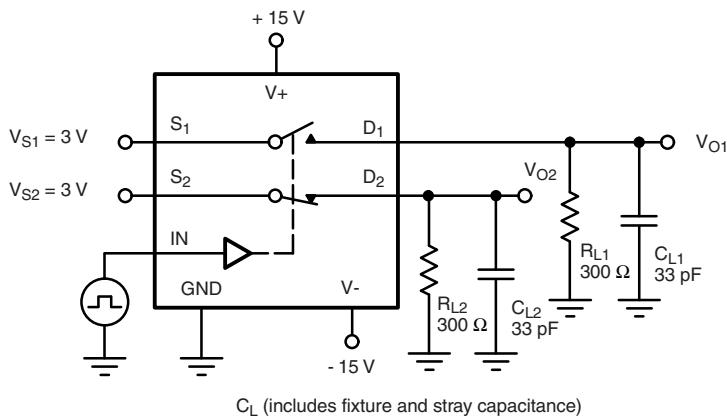
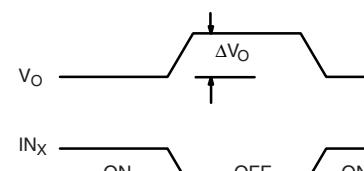
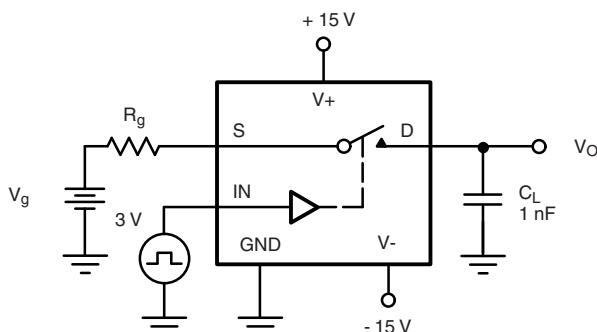
**Notes**

- 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 datasheet
- 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** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

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

 **$R_{DS(on)}$  vs.  $V_D$  and Temperature**

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

**Switching Time and Break-Before-Make Time vs. Positive Supply Voltage**

**Charge Injection vs. Analog Voltage**

**Input Switching Threshold vs. Positive Supply Voltage**

**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

**Supply Current vs. Temperature**

**Off Isolation and Crosstalk vs. Frequency**

**Supply Current vs. Switching Frequency**

**Leakage vs. Temperature**

**Switching Time vs. Power Supply Voltage**

**Switching Time vs. Temperature**

**TEST CIRCUITS**

**Fig. 2 - Switching Time**

**Fig. 3 - Break-Before-Make SPDT (DG303B)**

**Fig. 4 - Charge Injection**
**APPLICATIONS HINTS <sup>a</sup>**

V <sub>+</sub> POSITIVE SUPPLY VOLTAGE (V)	V <sub>-</sub> 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>P</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 DG303B 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")

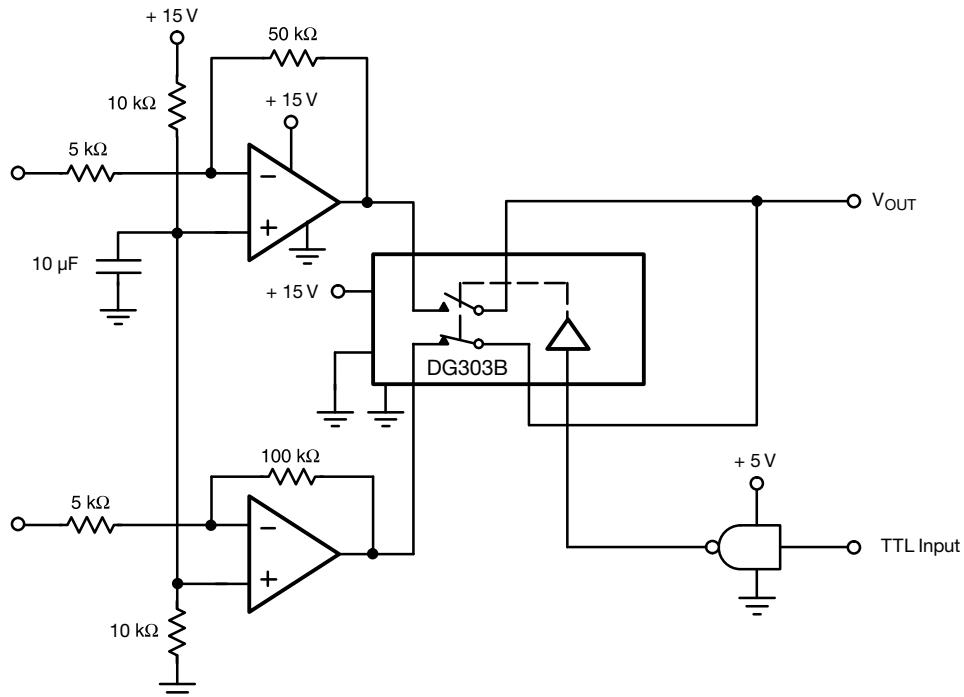


Fig. 5 - Single Supply Op. Amp. Switching

## APPLICATIONS

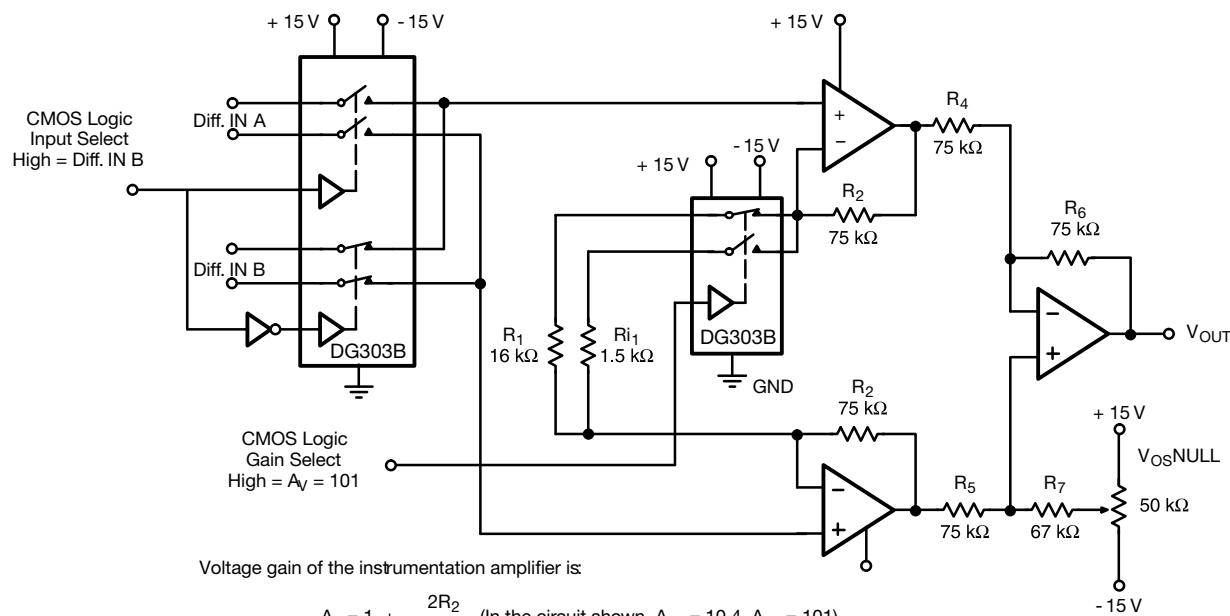


Fig. 6 - Low Power Instrumentation Amplifier with Digitally Selectable Inputs and Gain

**PRODUCT SUMMARY**

Part number	DG303B
Status code	2
Configuration	DPST x 2, comp
Single supply min. (V)	5
Single supply max. (V)	36
Dual supply min. (V)	5
Dual supply max. (V)	22
On-resistance ( $\Omega$ )	15
Charge injection (pC)	8
Source on capacitance (pF)	40
Source off capacitance (pF)	14
Leakage switch on typ. (nA)	0.1
Leakage switch off max. (nA)	5
-3 dB bandwidth (MHz)	-
Package	SO-14 (narrow) AS
Functional circuit / applications	Multi purpose, instrumentation, medical and healthcare
Interface	Parallel
Single supply operation	Yes
Dual supply operation	Yes
Turn on time max. (ns)	150
Crosstalk and off isolation	-62

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?61559](http://www.vishay.com/ppg?61559).

## 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.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. 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.