CMOS Analog Switches

(Obsolete for non-hermetic. Use DG300B Series as pin-for-pin replacements.)

FEATURES

- Analog Signal Range: ±15 V
- Fast Switching—t_{ON}: 150 ns
- Low On-Resistance—$r_{DS(on)}$: 30 Ω
- 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_MIL/DG301A_MIL/DG302A_MIL 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.

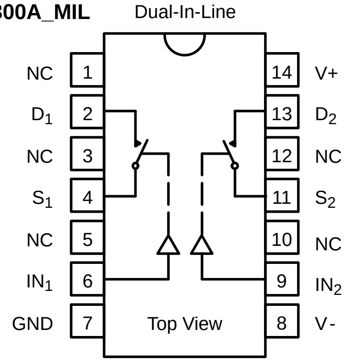
Designed on the Vishay Siliconix PLUS-40 CMOS process, these switches are latch-up proof, and are designed to block up to 30 V peak-to-peak when off. An epitaxial layer prevents latchup.

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.

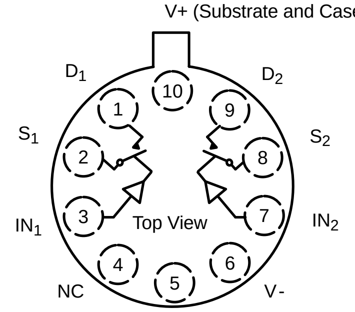
FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG300A_MIL Dual-In-Line



DG300A_MIL Metal Can

V+ (Substrate and Case)



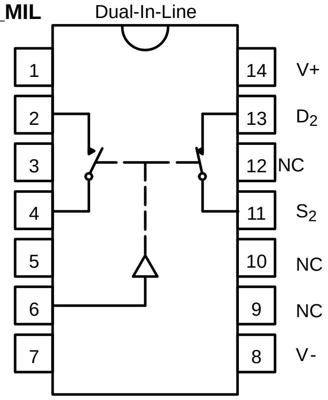
GND

TRUTH TABLE

Logic	Switch
0	OFF
1	ON

Logic "0" ≤ 0.8 V
Logic "1" ≥ 4 V

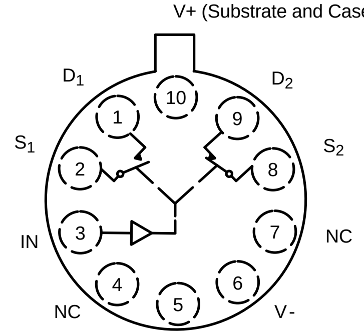
DG301A_MIL Dual-In-Line



Top View

DG301A_MIL Metal Can

V+ (Substrate and Case)



GND

Top View

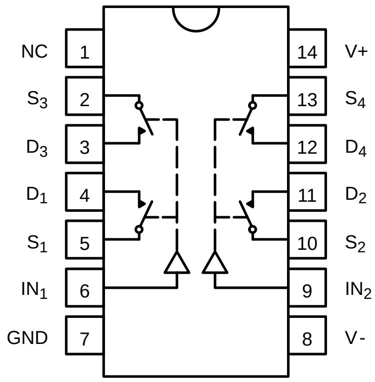
TRUTH TABLE

Logic	SW_1	SW_2
0	OFF	ON
1	ON	OFF

Logic "0" ≤ 0.8 V
Logic "1" ≥ 4 V

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG302A_MIL Dual-In-Line



Top View

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

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

ORDERING INFORMATION		
Temp Range	**Package**	**Part Number**
DG300A_MIL		
-55 to 125°C	14-Pin CerDIP	DG300AAK
		DG300AAK/883
		JM38510/11601BCA
	14-Pin Sidebraze	JM38510/11601BCC
	10-Pin Metal Can	DG300AAA/883
		JM38510/11601BIA
DG301A_MIL		
-55 to 125°C	14-Pin CerDIP	DG301AAK/883
		JM38510/11602BCA
	14-Pin Sidebraze	JM38510/11602BCC
	10-Pin Metal Can	DG301AAA
		DG301AAA/883
		JM38510/11602BIA
DG302A_MIL		
-55 to 125°C	14-Pin CerDIP	DG302AAK
		DG302AAK/883
		JM38510/11603BCA
	14-Pin Sidebraze	JM38510/11603BCC

ABSOLUTE MAXIMUM RATINGS

Voltages Referenced to V-
V+ .... 44 V
GND .... 25 V
Digital Inputs[a], V_S, V_D .... (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 Dissipationb
14-Pin CerDIP[c] .... 825 mW
10-Pin Metal Can[d] .... 450 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 75°C
d. Derate 6 mW/°C above 75°C

SCHEMATIC DIAGRAM (TYPICAL CHANNEL)

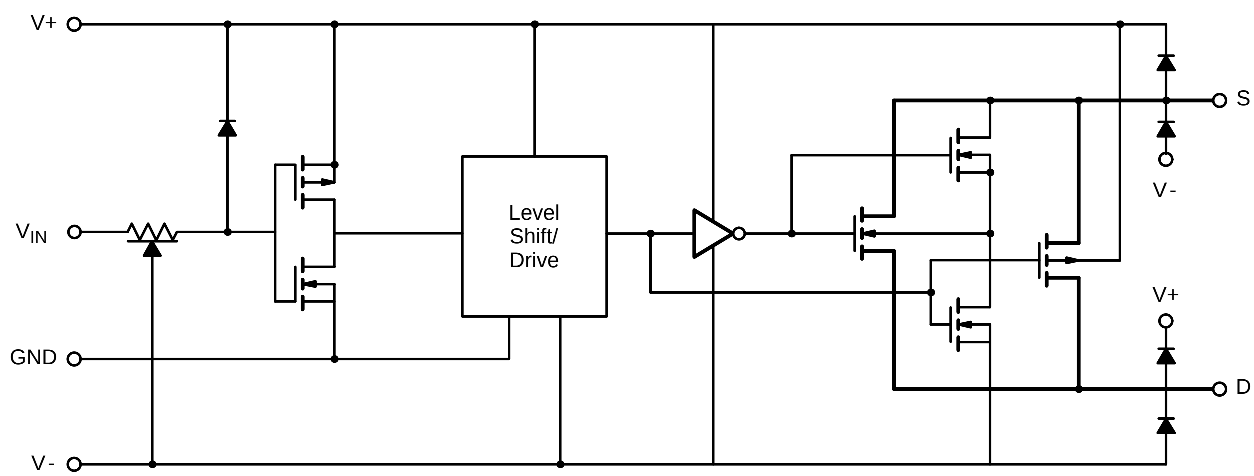


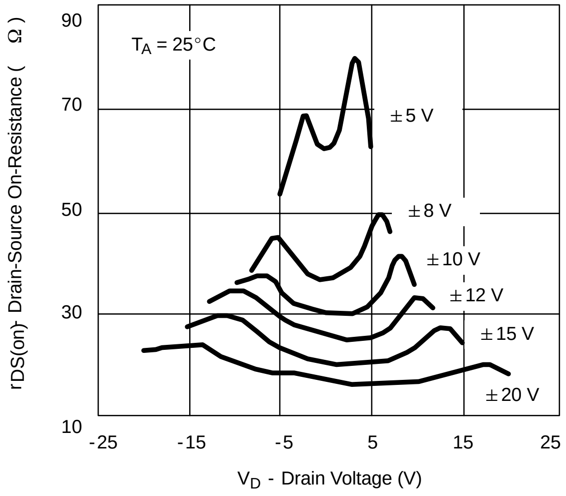
FIGURE 1.

SPECIFICATIONS[a]							
Parameter	Symbol	Test Conditions Unless Specified V+ = 15 V, V- = -15 V V_{IN} = 0.8 V or V_{IN} = 4 V[f]	Temp[b]	Limits Min[c]	Typ[d]	Max[c]	Unit
Analog Switch							
Analog Signal Range[e]	V_{ANALOG}		Full	-15		15	V
Drain-Source On-Resistance	$r_{DS(on)}$	$V_D = \pm 10$ V, I_S = -10 mA	Room Full		30	50 75	Ω
Source Off Leakage Current	$I_{S(off)}$	$V_S = \pm 14$ V, $V_D = \mp 14$ V	Room Hot	-1 -100	±0.1	1 100	nA
Drain Off Leakage Current	$I_{D(off)}$	$V_S = \pm 14$ V, $V_D = \mp 14$ V	Room Hot	-1 -100	±0.1	1 100	nA
Drain On Leakage Current	$I_{D(on)}$	$V_D = V_S = \pm 14$ V	Room Hot	-1 -100	±0.1	1 100	nA
Digital Control							
Input Current with Input Voltage High	I_{INH}	V_{IN} = 5 V	Room Full	-1 -1	-0.001		µA
		V_{IN} = 15 V	Room Full		0.001	1 1	µA
Input Current with Input Voltage Low	I_{INL}	V_{IN} = 0 V	Room Full	-1 -1	-0.001		µA
Dynamic Characteristics							
Turn-On Time	t_{ON}	See Figure 2	Room		150	300	ns
Turn-Off Time	t_{OFF}	See Figure 2	Room		130	250	ns
Break-Before-Make Time	t_{OPEN}	DG301A_MIL Only Figure 3	Room		50		ns
Charge Injection	Q	C_L = 1 nF, R_{gen} = 0 Ω V_{gen} = 0 V, Figure 4	Room		8		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} = 4 V (One Input) All Others = 0 V	Room Full		0.23	0.5 1	mA
Negative Supply Current	I-	V_{IN} = 4 V (One Input) All Others = 0 V	Room Full	-10 -100	-0.001		µA
Positive Supply Current	I+	V_{IN} = 0.8 V (All Inputs)	Room Full		0.001	10 100	µA
Negative Supply Current	I-	V_{IN} = 0.8 V (All Inputs)	Room Full	-10 -100	-0.001		µA

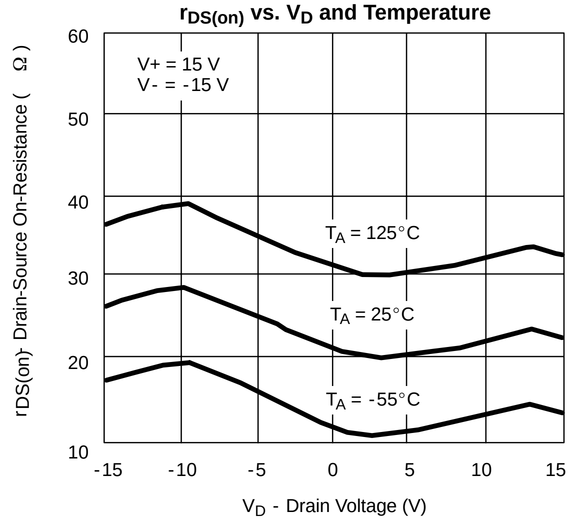
Notes:
a. Refer to PROCESS OPTION FLOWCHART.
b. Room = 25°C, Full = as determined by the operating temperature suffix.
c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
d. Typical values are for DESIGN AID ONLY, not guaranteed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

TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

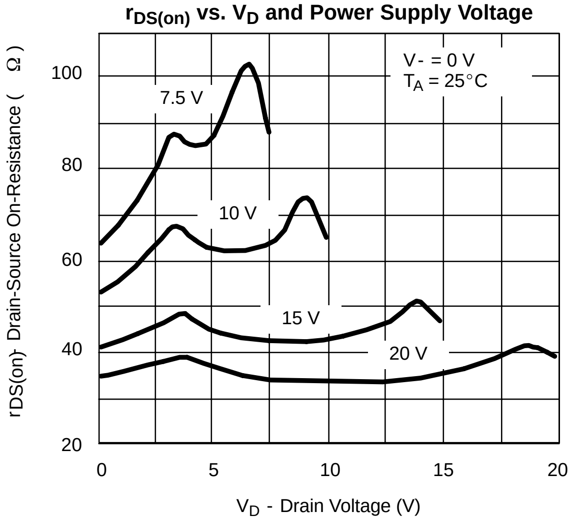
$r_{DS(on)}$ vs. V_D and Power Supply



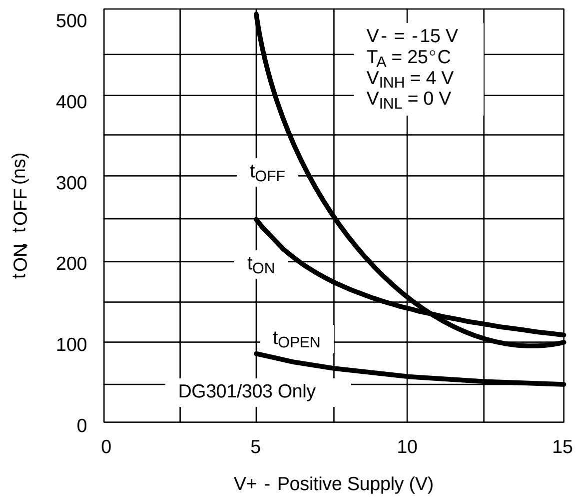
$r_{DS(on)}$ vs. V_D and Temperature



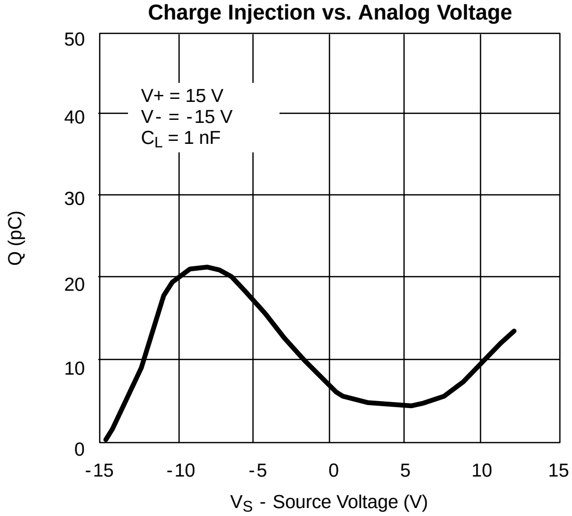
$r_{DS(on)}$ vs. V_D and Power Supply Voltage



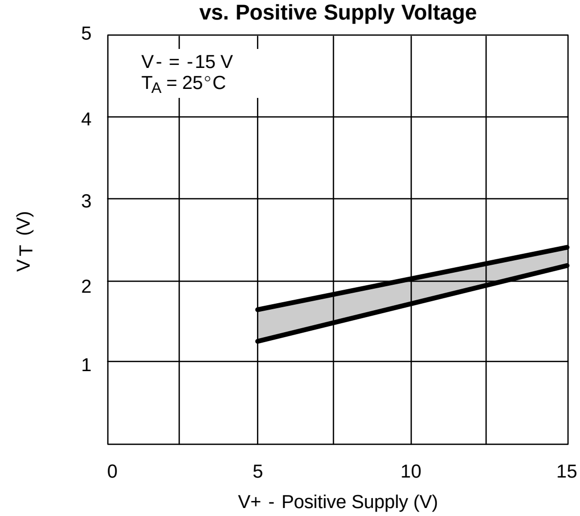
Switching Time and Break-Before-Make Time vs. Positive Supply Voltage



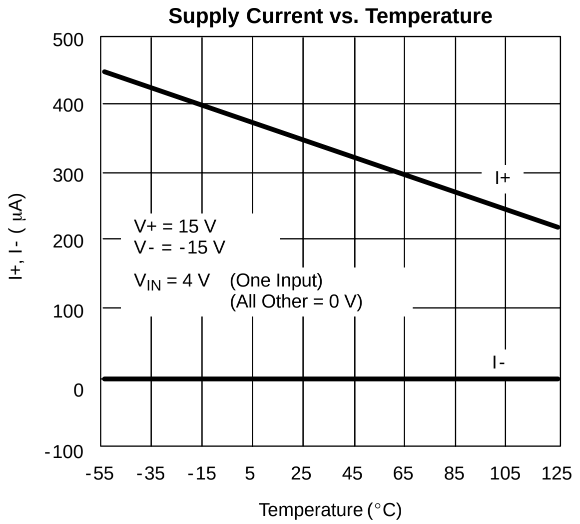
Charge Injection vs. Analog Voltage

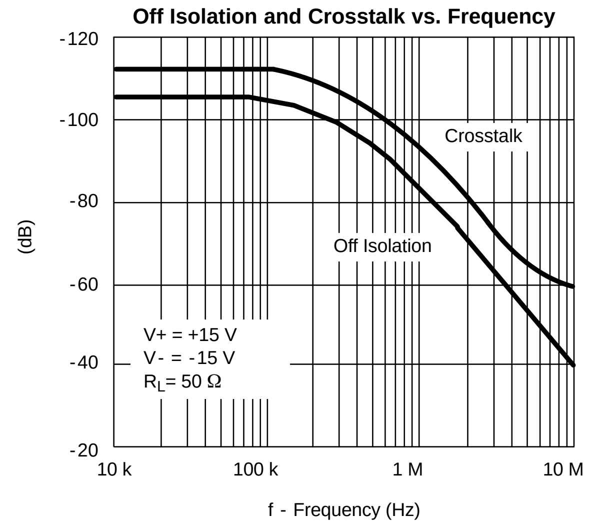


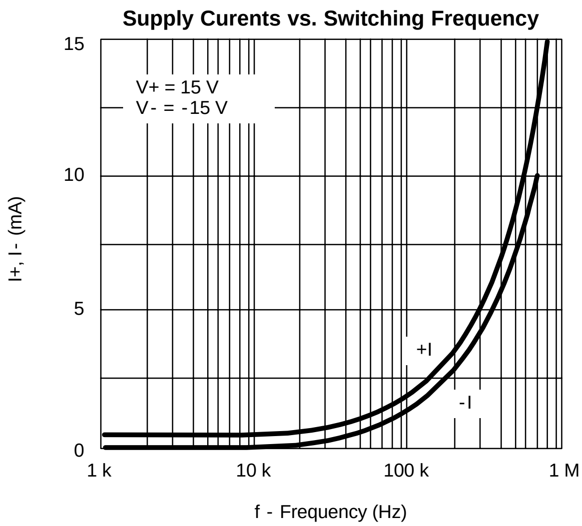
Input Switching Threshold vs. Positive Supply Voltage

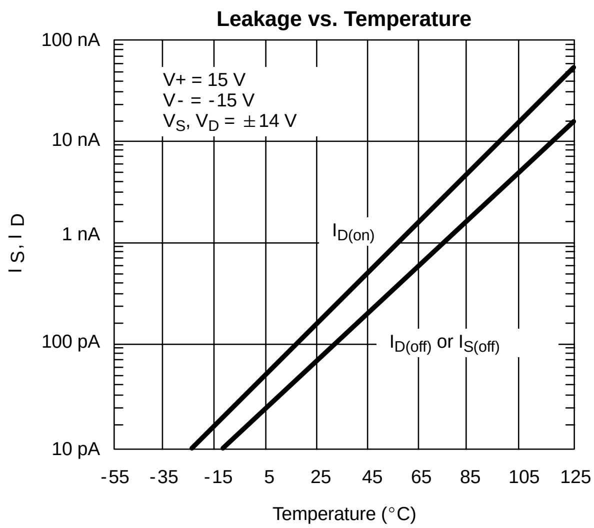


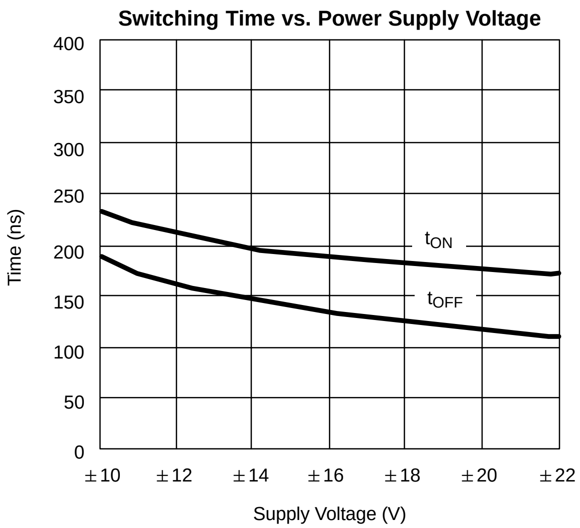
TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

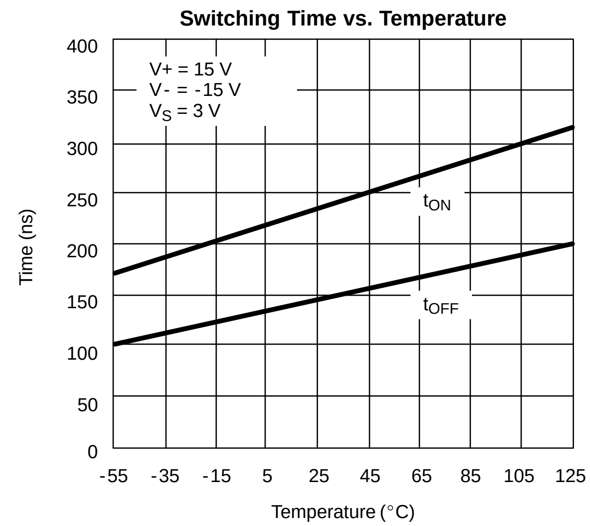












TEST CIRCUITS

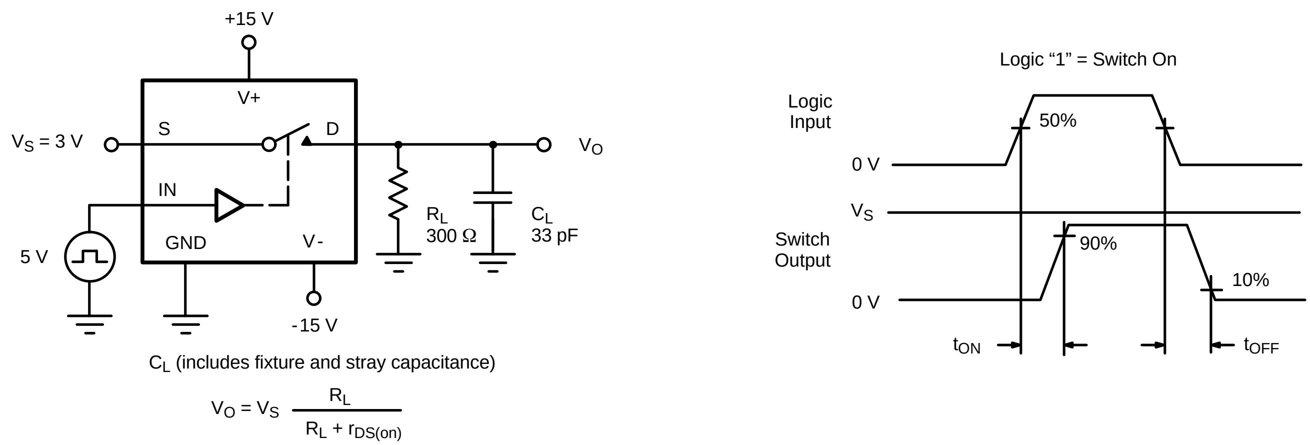


FIGURE 2. Switching Time

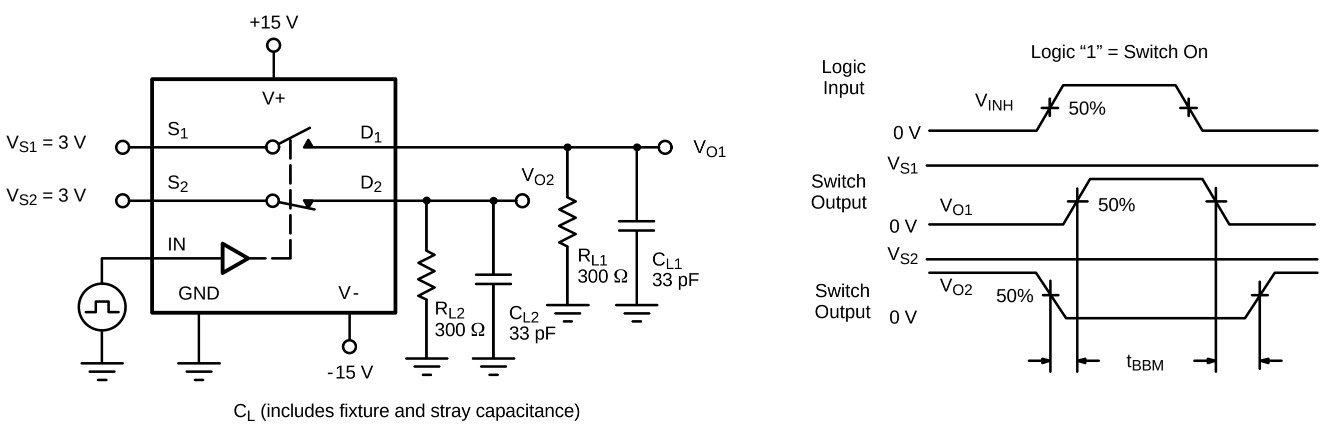


FIGURE 3. Break-Before-Make SPDT (DG301A_MIL)

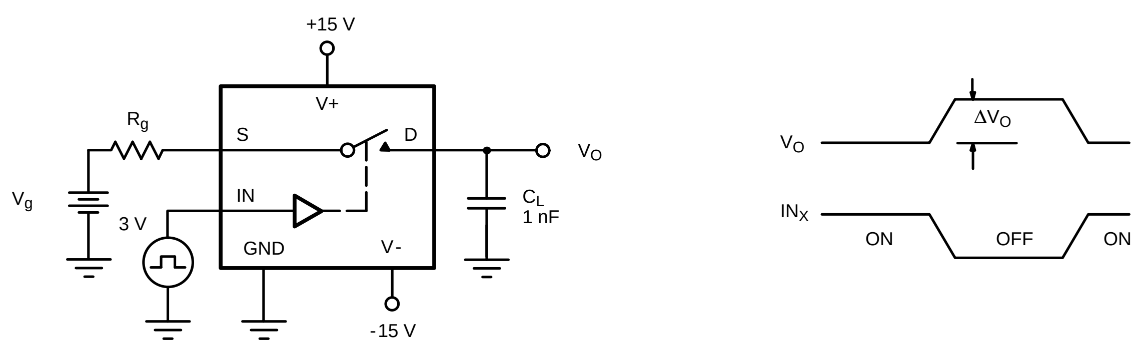


FIGURE 4. Charge Injection

APPLICATION 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	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_MIL 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.)

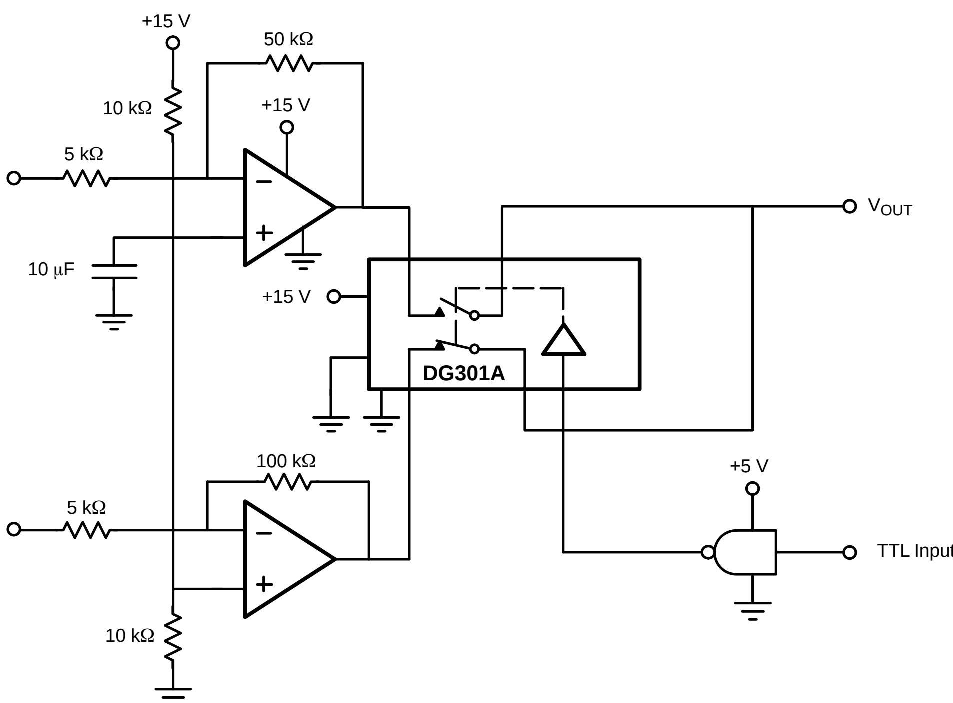


FIGURE 5. Single Supply Op Amp Switching

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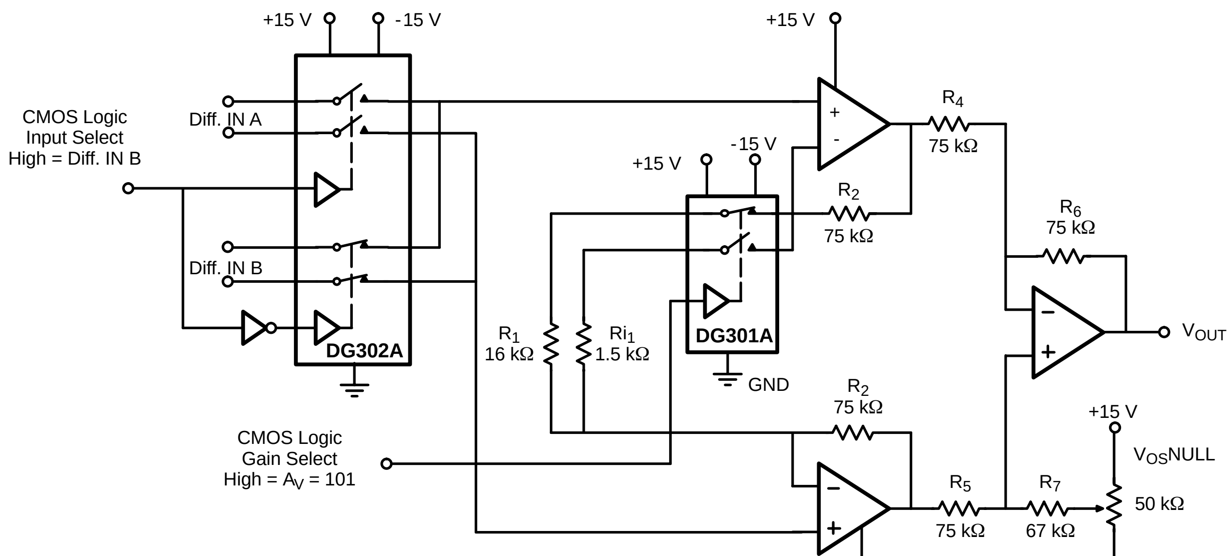
APPLICATIONS



Voltage gain of the instrumentation amplifier is:

$$A_V = 1 + \frac{2R_2}{R_1} \quad \text{(In the circuit shown, } A_{V1} = 10.4,\ A_{V2} = 101\text{)}$$

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

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