



# DG300A/301A/302A/303A CMOS Analog Switches

T-51-11

## FEATURES

- Analog Signal Range  $\pm 15$  V
- Fast Switching (< 250 ns)
- Low  $r_{DS(ON)}$  (< 50  $\Omega$ )
- Single Supply Operation
- Latchproof CMOS

## 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 Operated Circuits

## 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 proof, and are designed to block up to 30 Volts 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 fairly flat ON resistance.

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

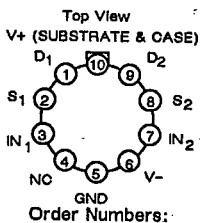
Package options for this series include 14-pin CerDIP and plastic DIP. Performance grades include the military, A suffix (-55 to 125°C), commercial, C suffix (0 to 70°C), and industrial, B suffix (-25 to 85°C) temperature ranges. Additionally, the DG300A and DG301A are available in 10-pin metal cans, while the DG301A and DG303A are available in 20-pin LCC packages.



## PIN CONFIGURATION

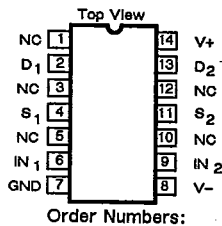
## FUNCTIONAL BLOCK DIAGRAM

Metal Can Package



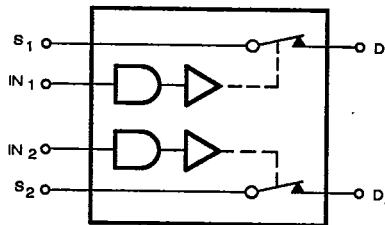
DG300AAA, DG300AAA/883  
DG300ABA, DG300ACA

Dual-In-Line Package



CerDIP: DG300AAK, DG300AAK/883  
DG300ABK, DG300ACK  
Plastic: DG300ACJ

DG300A



Two SPST Switches per Package\*

LOGIC	SWITCH
0	OFF
1	ON

Logic "0"  $\leq 0.8$  V  
Logic "1"  $\geq 4.0$  V

Switches Shown for Logic "1" Input

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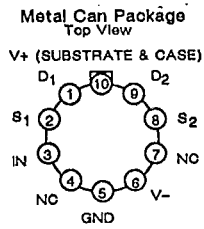
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# DG300A/301A/302A/303A

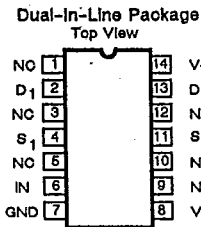


PIN CONFIGURATION (Cont'd)

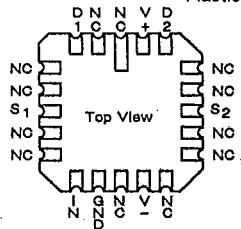
FUNCTIONAL BLOCK DIAGRAM (Cont'd)



Order Numbers:  
DG301AAA, DG301AAA/883  
DG301ABA, DG301ACA



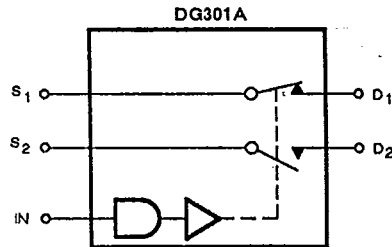
Order Numbers:  
CerDIP: DG301AAK, DG301AAK/883  
DG301ACK, DG301ABK  
Plastlo: DG301ACJ



LCC Package

Order Number:  
DG301AAZ/883

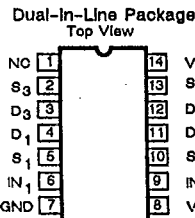
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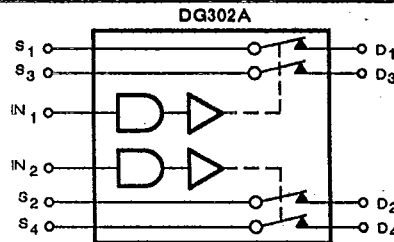
One SPDT Switch per Package\*

TRUTH TABLE\*\*

LOGIC	SW1	SW2
0	OFF	ON
1	ON	OFF



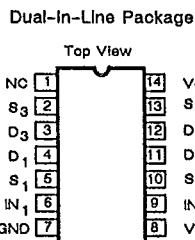
Order Numbers:  
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DG302ABK, DG302ACK  
Plastlo: DG302ACJ



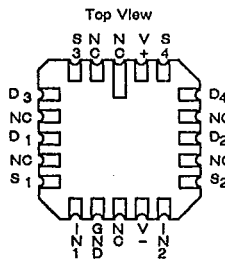
Two DPST Switches per Package\*

TRUTH TABLE\*\*

LOGIC	SWITCH
0	OFF
1	ON

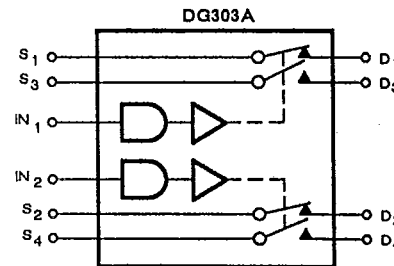


Order Numbers:  
CerDIP: DG303AAK, DG303AAK/883  
DG303ABK, DG303ACK  
Plastlo: DG303ACJ



LCC Package

Order Number:  
DG303AAZ/883



Two SPDT Switches per Package\*

TRUTH TABLE\*\*

LOGIC	SW1 SW2	SW3 SW4
0	OFF	ON
1	ON	OFF

\* Switches Shown for Logic "1" Input  
\*\* Logic "0" ≤ 0.8 V, Logic "1" ≥ 4.0 V

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# DG300A/301A/302A/303A

## ABSOLUTE MAXIMUM RATINGS

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Voltages Referenced to V-

V+ ..... 44 V

GND ..... 25 V

Digital Inputs, V<sub>S</sub>, V<sub>D</sub><sup>o</sup> ..... (V-) -2 V to (V+) +2V or  
30 mA, whichever occurs first.

Current, Any Terminal Except S or D ..... 30 mA

Continuous Current, S or D ..... 30 mA  
(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

Operating Temperature (A Suffix) ..... -55 to 125°C  
(B Suffix) ..... -25 to 85°C  
(C Suffix) ..... 0 to 70°C

Power Dissipation\*  
14-Pin CerDIP (K)\*\* ..... 825 mW  
10-Pin Metal Can (A)\*\*\* ..... 450 mW  
14-Pin Plastic DIP (J)\*\*\*\* ..... 470 mW

- \* Device mounted with all leads soldered or welded to PC board.
- \*\* Derate 11 mW/°C above 75°C.
- \*\*\* Derate 6 mW/°C above 75°C.
- \*\*\*\* Derate 6.5 mW/°C above 75°C.

ELECTRICAL CHARACTERISTICS <sup>a</sup>									
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V <sub>+</sub> = 15 V V <sub>-</sub> = -15 V GND = 0 V	LIMITS						UNIT
			1=25°C		A SUFFIX		B, C SUFFIX		
			TEMP	TYP <sup>d</sup>	MIN <sup>b</sup>	MAX <sup>b</sup>	MIN <sup>b</sup>	MAX <sup>b</sup>	
<b>SWITCH</b>									
Analog Signal Range <sup>o</sup>	V <sub>ANALOG</sub>		1,2,3		-15	15	-15	15	V
Drain-Source ON Resistance	r <sub>DS(ON)</sub>	V <sub>D</sub> = 10 V I <sub>S</sub> = -10 mA	1,3 2	30		50 75		50 75	Ω
		V <sub>D</sub> = -10 V I <sub>S</sub> = 10 mA	1,3 2	30		50 75		50 75	
Source OFF Leakage Current	I <sub>S(OFF)</sub>	V <sub>S</sub> = 14 V V <sub>D</sub> = -14 V	1 2	0.1		1 100		5 100	nA
		V <sub>S</sub> = -14 V V <sub>D</sub> = 14 V	1 2	-0.1	-1 -100		-5 -100		
Drain OFF Leakage Current	I <sub>D(OFF)</sub>	V <sub>D</sub> = 14 V V <sub>S</sub> = -14 V	1 2	0.1		1 100		5 100	
		V <sub>D</sub> = -14 V V <sub>S</sub> = 14 V	1 2	-0.1	-1 -100		-5 -100		
Drain ON Leakage Current	I <sub>D(ON)</sub>	V <sub>D</sub> = V <sub>S</sub> = 14 V	1 2	0.1		1 100		5 100	
		V <sub>D</sub> = V <sub>S</sub> = -14 V	1 2	-0.1	-2 -200		-5 -200		
<b>INPUT</b>									
Input Current with Input Voltage HIGH	I <sub>INH</sub>	V <sub>IN</sub> = 5 V	1 2,3	-0.001	-1 -1		-1		μA
		V <sub>IN</sub> = 15 V	1 2,3	0.001		1 1		1	
Input Current with Input Voltage LOW	I <sub>INL</sub>	V <sub>IN</sub> = 0 V	1 2,3	-0.001	-1 -1		-1		

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DG300A/301A/302A/303A



ELECTRICAL CHARACTERISTICS<sup>a</sup>

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PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V <sub>I+</sub> = 15 V V <sub>I-</sub> = -15 V GND = 0 V	LIMITS						UNIT
			1=25°C 2=125,85,70°C 3=-55,-25,0°C		A SUFFIX -55 to 125°C		B, C SUFFIX		
			TEMP	TYP <sup>d</sup>	MIN <sup>b</sup>	MAX <sup>b</sup>	MIN <sup>b</sup>	MAX <sup>b</sup>	
<b>DYNAMIC</b>									
Turn-ON Time	t <sub>ON</sub>	See Switching Time Test Circuit	1	150		300			ns
Turn-OFF Time	t <sub>OFF</sub>		1	130		250			
Break-Before-Make Interval	t <sub>ON</sub> - t <sub>OFF</sub>	See Break-Before-Make Test Time Circuit DG301A/303A ONLY	1	50					
Charge Injection	Q	C <sub>L</sub> = 1 nF, R <sub>gen</sub> = 0Ω V <sub>gen</sub> = 0 V	1	3					pC
Source-OFF Capacitance	C <sub>S(OFF)</sub>	V <sub>IN</sub> = 0.8 V or V <sub>IN</sub> = 4.0 V f = 1 MHz	V <sub>S</sub> = 0 V	1	14				pF
Drain-OFF Capacitance	C <sub>D(OFF)</sub>		V <sub>D</sub> = 0 V	1	14				
Channel-ON Capacitance	C <sub>D(ON)</sub> + C <sub>S(ON)</sub>		V <sub>S</sub> = V <sub>D</sub> = 0 V	1	40				
Input Capacitance	C <sub>in</sub>	f = 1 MHz	V <sub>IN</sub> = 0 V	1	6				
		V <sub>IN</sub> = 15 V	1	7					
OFF Isolation		V <sub>IN</sub> = 0 V R <sub>L</sub> = 1 kΩ	1	62				dB	
Crosstalk (Channel-to-Channel)		V <sub>S</sub> = 1 V <sub>rms</sub> f = 500 kHz	1	74					
<b>SUPPLY</b>									
Positive Supply Current	I <sub>+</sub>	V <sub>IN</sub> = 4.0 V (One Input) (All Others = 0 V)	1,2 3	0.23		0.5 1		1.0	mA
Negative Supply Current	I <sub>-</sub>		1,3 2	-0.001	-10 -100		-100		
Positive Supply Current	I <sub>+</sub>	V <sub>IN</sub> = 0.8 V (All Inputs)	1,3 2	0.001		10 100		100	μA
Negative Supply Current	I <sub>-</sub>		1,3 2	-0.001	-10 -100		-100		

NOTES:

- a. Refer to PROCESS OPTION FLOWCHART for additional information.
- b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- c. Guaranteed by design, not subject to production test.
- d. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- e. Signals on S<sub>X</sub>, D<sub>X</sub>, or I<sub>NX</sub> exceeding V<sub>I+</sub> or V<sub>I-</sub> will be clamped by internal diodes. Limit diode forward current to maximum current ratings.
- f. OFF Isolation : 20 log  $\frac{V_S}{V_D}$  . V<sub>S</sub> = Input to OFF switch, V<sub>D</sub> = Output.

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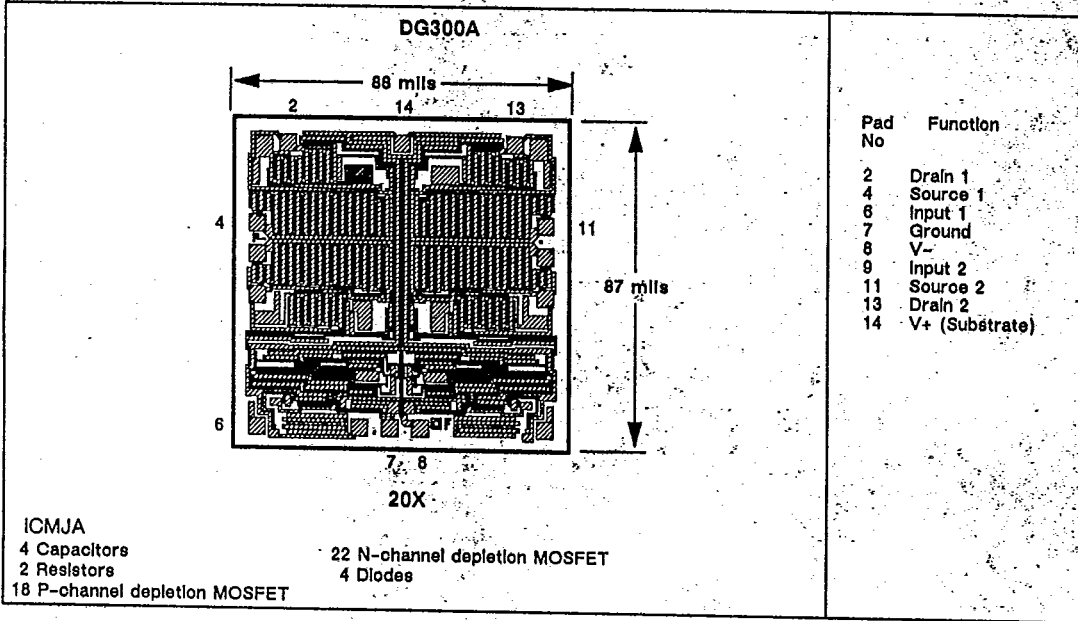
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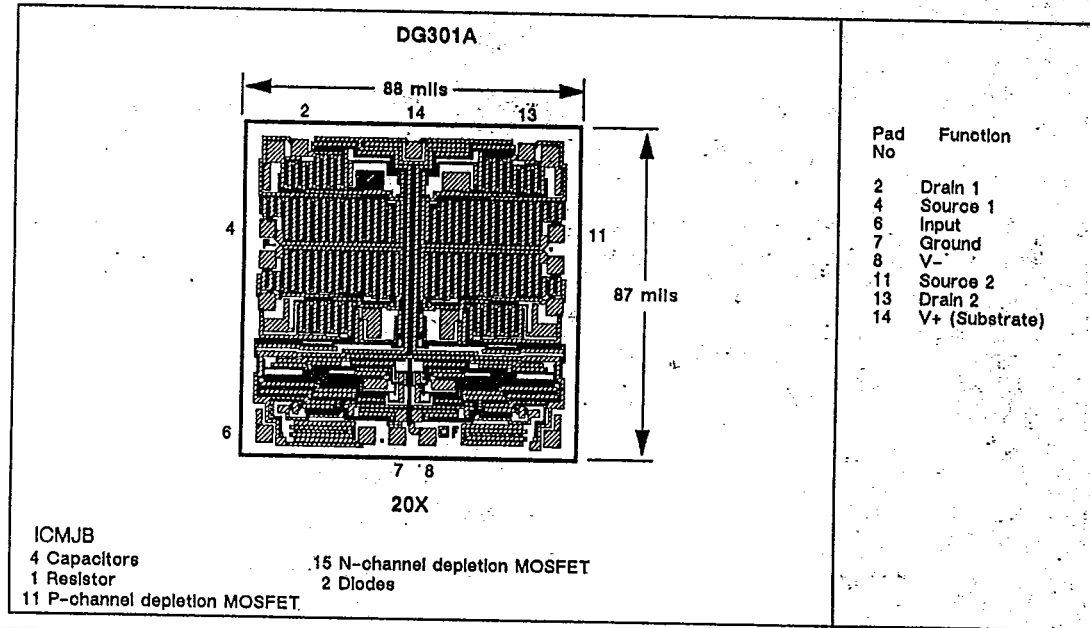
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DIE TOPOGRAPHY

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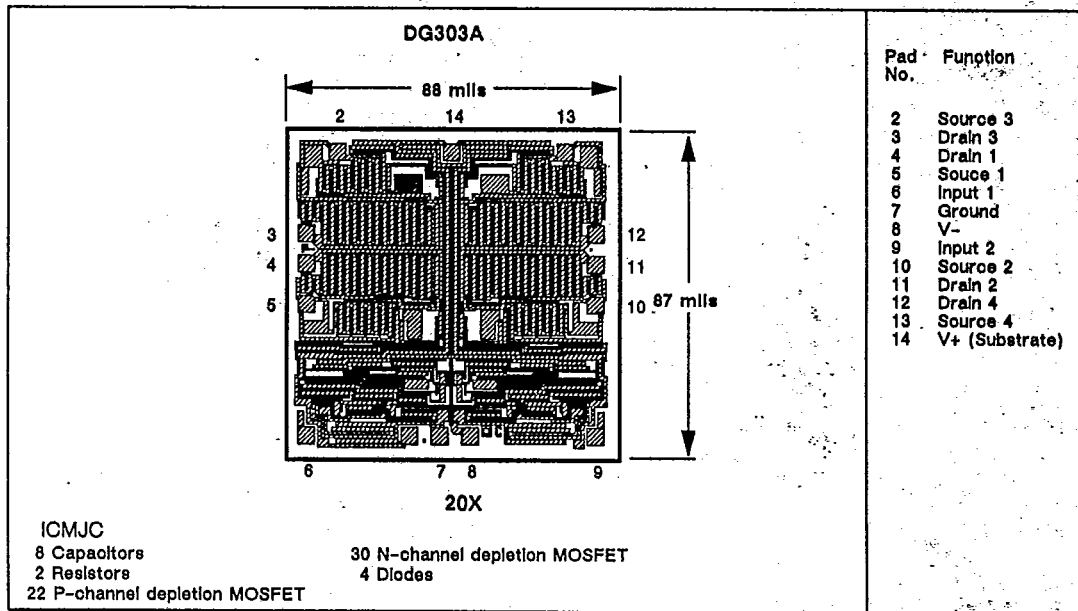
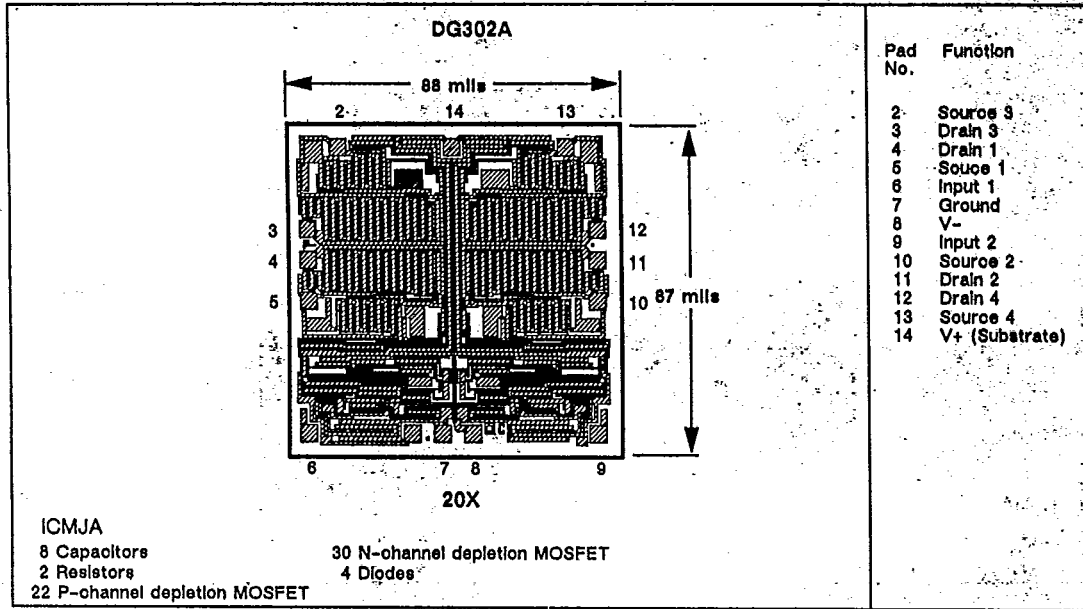


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DIE TOPOGRAPHY (Cont'd)

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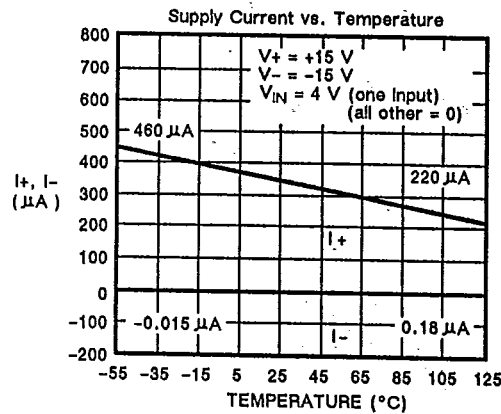
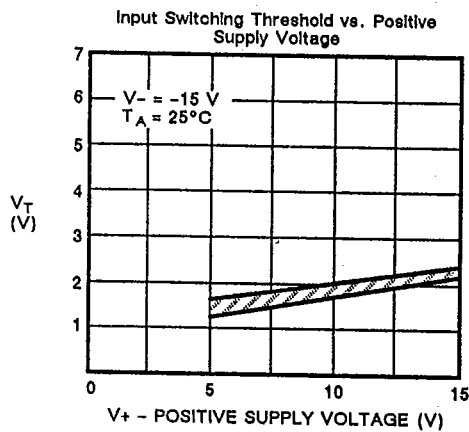
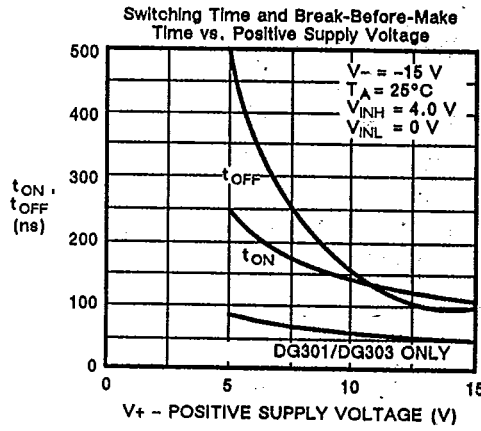
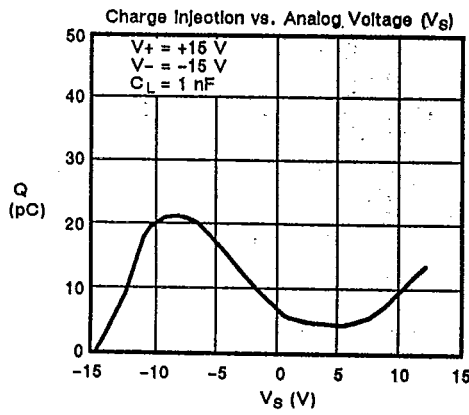
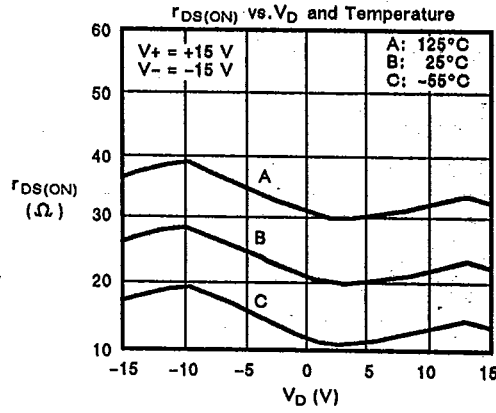
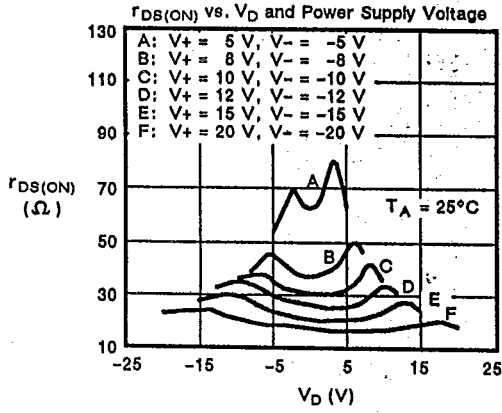
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TYPICAL CHARACTERISTICS

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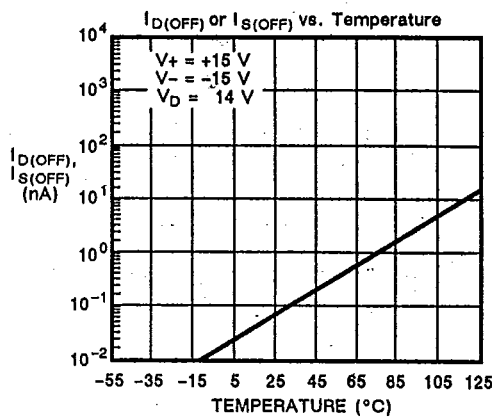
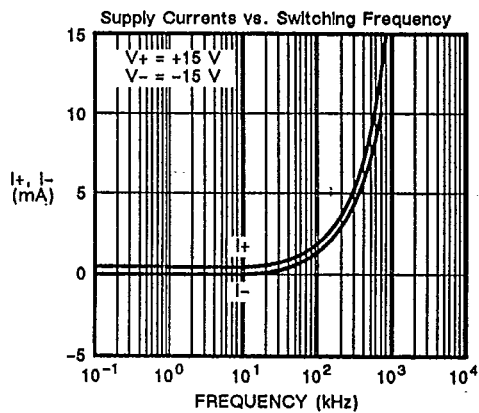
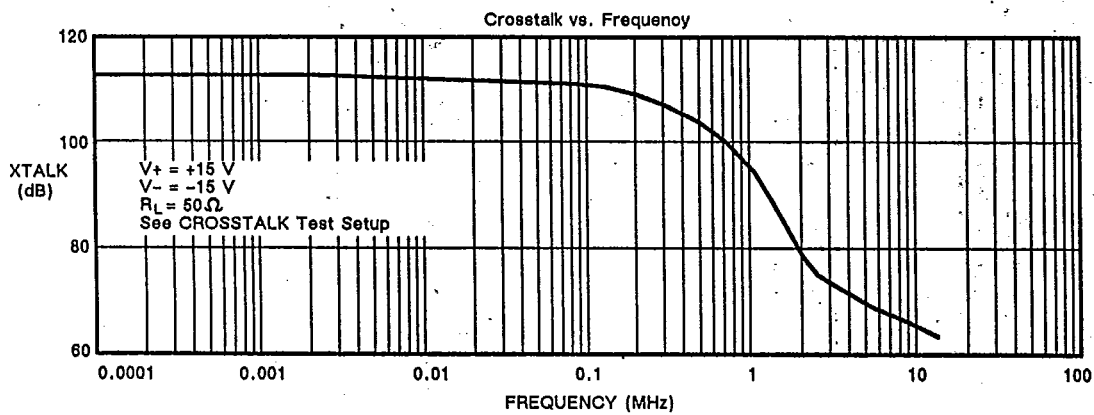
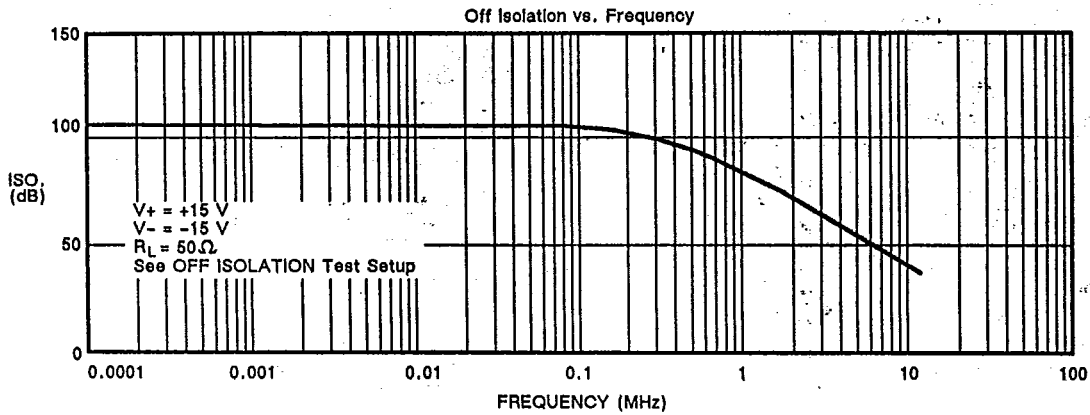
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TYPICAL CHARACTERISTICS (Cont'd)

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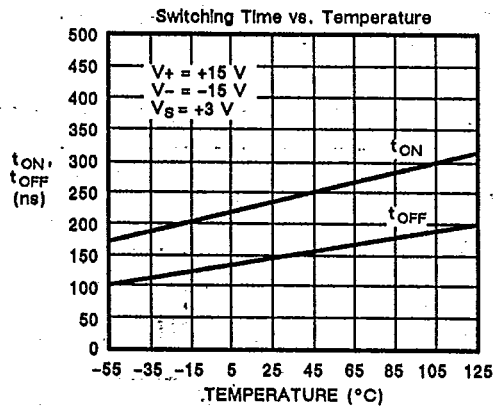
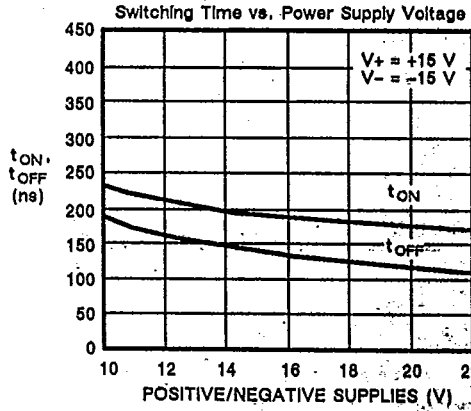
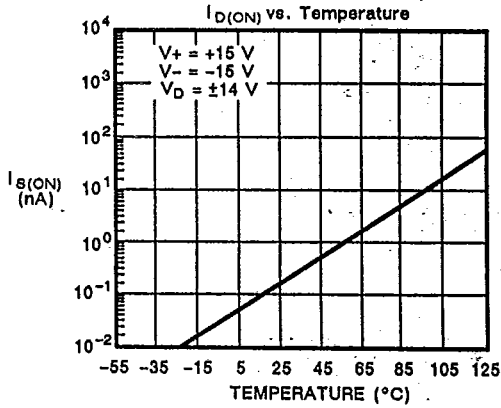
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# DG300A/301A/302A/303A

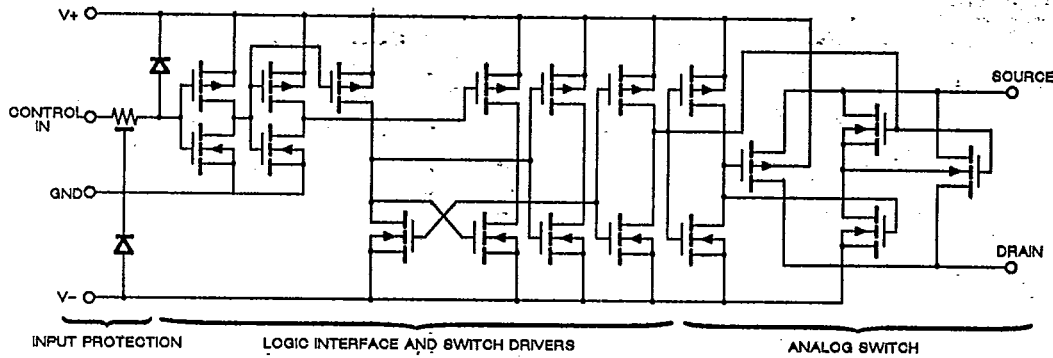
TYPICAL CHARACTERISTICS (Cont'd)

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**SCHEMATIC DIAGRAM (Typical Channel)**

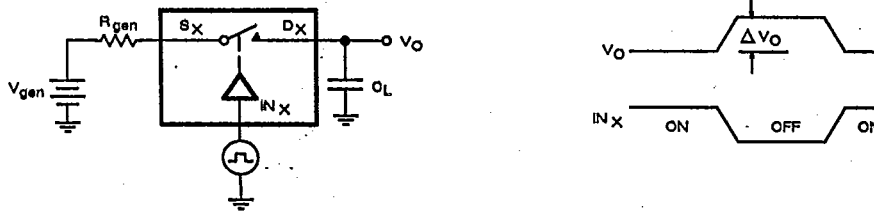


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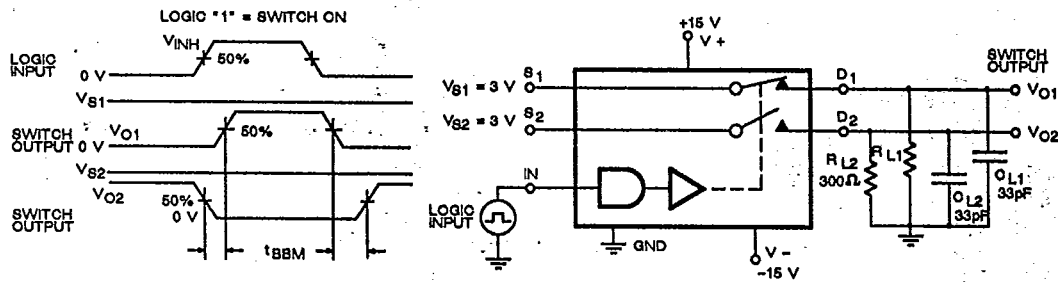


## CHARGE INJECTION TEST CIRCUIT

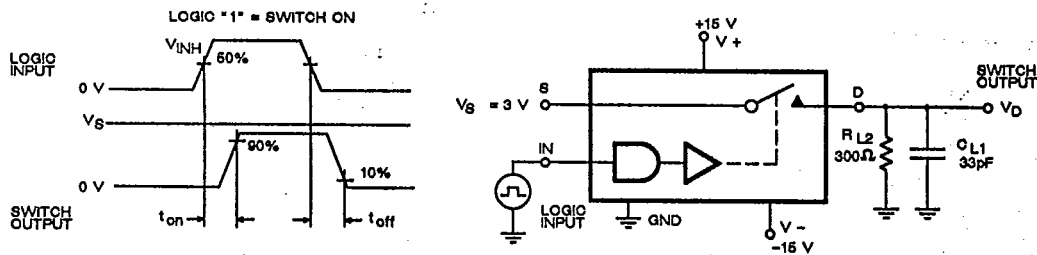
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## BREAK-BEFORE-MAKE TIME TEST CIRCUIT SPDT (DG301A, DG303A)



## SWITCHING TIME TEST CIRCUIT



## APPLICATION HINTS

V+ Positive Supply Voltage (V)	V- Negative Supply Voltage (V)	GND Voltage (V)	VIN Logic Input Voltage VINH Min/ VINL Max (V)	Vs 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

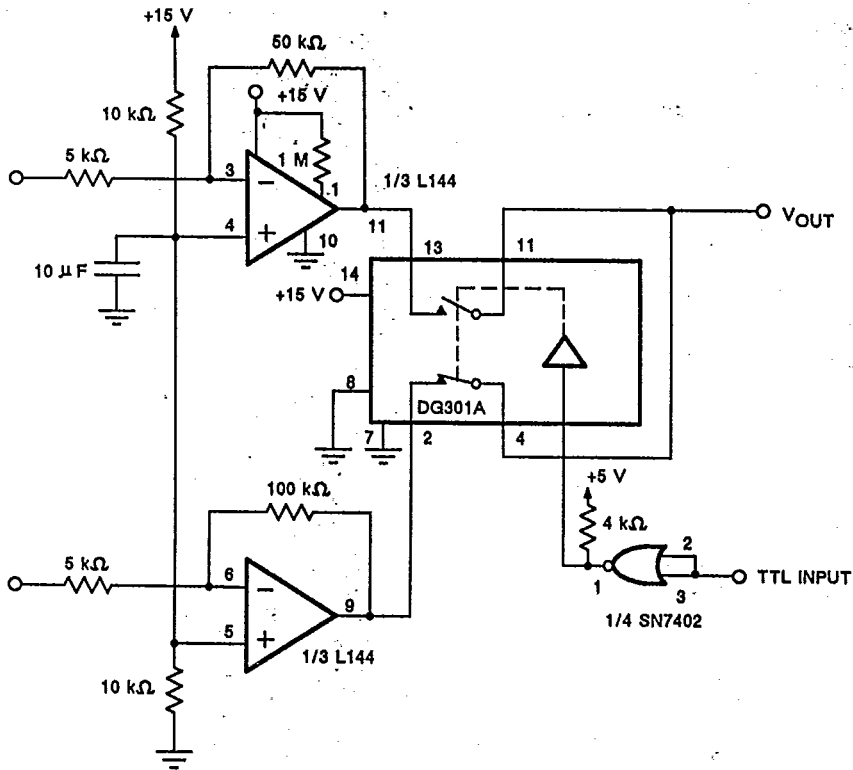
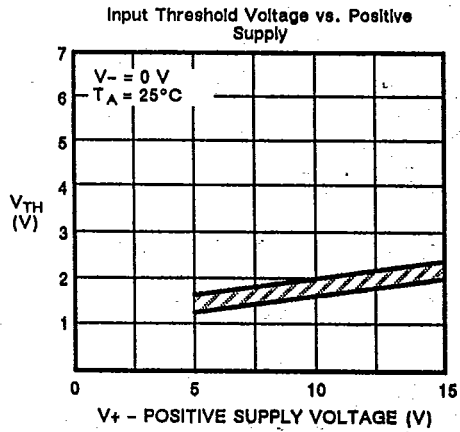


# DG300A/301A/302A/303A

## APPLICATIONS

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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. Typical curves for design aid are given in the figures below. The analog voltage should not go above or below the supply voltages which in single operation are  $V_+$  and 0 V.



Single Supply Op Amp Switching

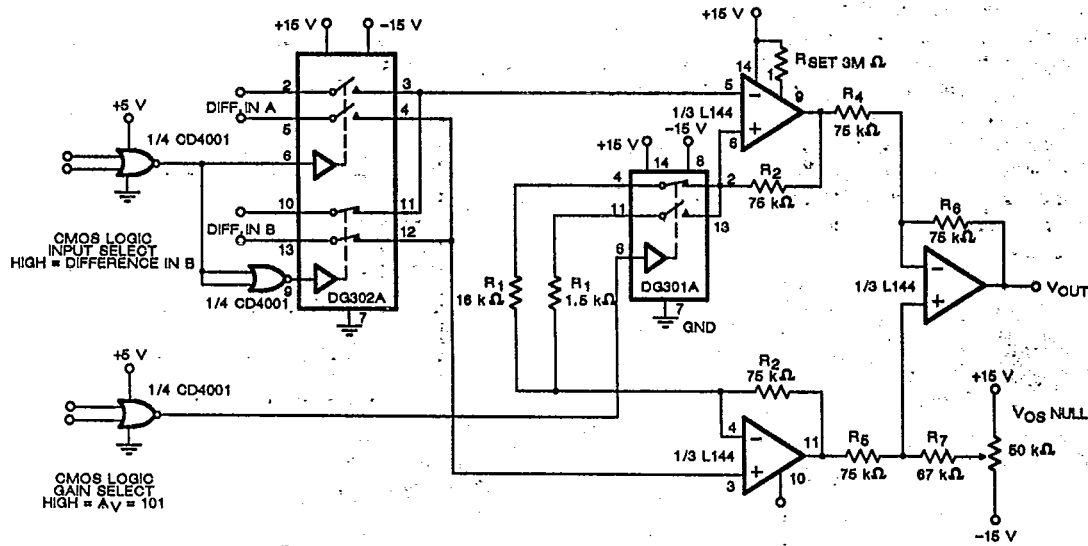
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DG300A/301A/302A/303A



APPLICATIONS (Cont'd)

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R<sub>SET</sub> programs L144 power dissipation, gain-bandwidth product. Refer to AN73-6 and the L144 data sheet.

Voltage gain of the Instrumentation amplifier is :

$$A_v = 1 + \frac{2R_2}{R_1} \quad (\text{In the circuit shown, } A_{v1} = 10.4, A_{v2} = 101)$$

Low Power Instrumentation Amplifier with Digitally Selectable Inputs and Gain