

# DG300A, DG301A, DG302A, DG303A

TTL-Compatible,  
CMOS Analog Switches

August 1997

## Features

- Low Power Consumption
- Break-Before-Make Switching (Typ)
  - $t_{OFF}$  ..... 130ns
  - $t_{ON}$  ..... 150ns
- TTL, CMOS Compatible
- Low  $r_{DS(ON)}$  .....  $\leq 50\Omega$
- Single Supply Operation
- True Second Source

## Description

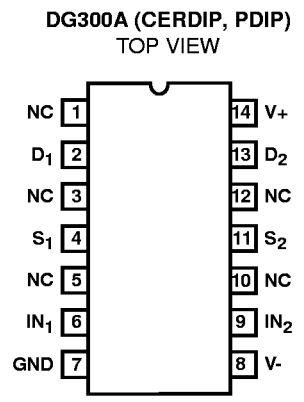
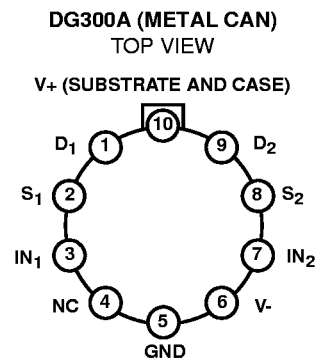
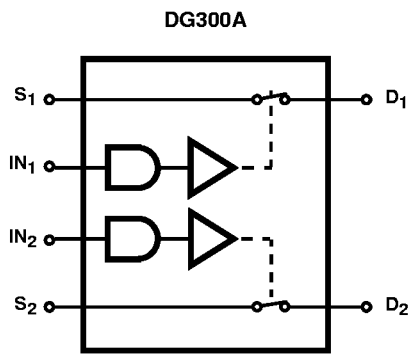
The DG300A through DG303A family of monolithic CMOS switches are truly compatible second source of the original manufacturer. The switches are latch-proof and are designed to block signals up to  $30V_{P-P}$  when OFF. Featuring low leakage and low power consumption, these switches are ideally suited for precision application in instrumentation, communication, data acquisition and battery powered applications. Other key features include Break-Before-Make switching, TTL and CMOS compatibility, and low ON resistance. Single supply operation (for positive switch voltages) is possible by connecting V- to 0V.

## Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
DG300AAK	-55 to 125	14 Ld Cerdip	F14.3
DG301AAK	-55 to 125	14 Ld Cerdip	F14.3
DG302AAK	-55 to 125	14 Ld Cerdip	F14.3
DG303AAK	-55 to 125	14 Ld Cerdip	F14.3
DG300ABK	-25 to 85	14 Ld Cerdip	F14.3
DG301ABK	-25 to 85	14 Ld Cerdip	F14.3
DG302ABK	-25 to 85	14 Ld Cerdip	F14.3
DG303ABK	-25 to 85	14 Ld Cerdip	F14.3
DG300ACK	0 to 70	14 Ld Cerdip	F14.3
DG301ACK	0 to 70	14 Ld Cerdip	F14.3
DG303ACK	0 to 70	14 Ld Cerdip	F14.3
DG300ACJ	0 to 70	14 Ld PDIP	E14.3

PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
DG301ACJ	0 to 70	14 Ld PDIP	E14.3
DG302ACJ	0 to 70	14 Ld PDIP	E14.3
DG303ACJ	0 to 70	14 Ld PDIP	E14.3
DG300AAA	-55 to 125	10 Pin Metal Can	T10.B
DG301AAA	-55 to 125	10 Pin Metal Can	T10.B
DG303ACY	0 to 70	16 Ld SOIC	M16.3
DG300AAA/883B	-55 to 125	10 Pin Metal Can	T10.B
DG300AAK/883B	-55 to 125	14 Ld Cerdip	F14.3
DG301AAA/883B	-55 to 125	10 Pin Metal Can	T10.B
DG301AAK/883B	-55 to 125	14 Ld Cerdip	F14.3
DG302AAK/883B	-55 to 125	14 Ld Cerdip	F14.3
DG303AAK/883B	-55 to 125	14 Ld Cerdip	F14.3

## Functional Diagrams and Pinouts



### TRUTH TABLE

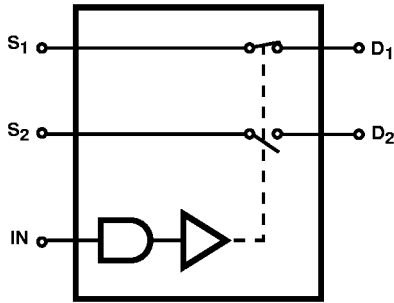
LOGIC	SWITCH
0	OFF
1	ON

Logic "0"  $\leq 0.8V$ , Logic "1"  $\geq 4.0V$ ; Two SPST switches per package (switches shown for Logic "1" input)

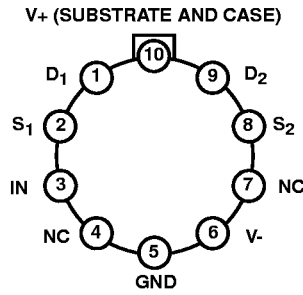
# DG300A, DG301A, DG302A, DG303A

## Functional Diagrams and Pinouts (Continued)

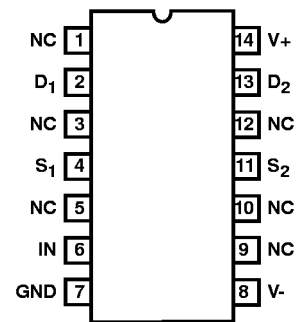
DG301A



DG301A (METAL CAN)  
TOP VIEW



DG301A (CERDIP, PDIP)  
TOP VIEW

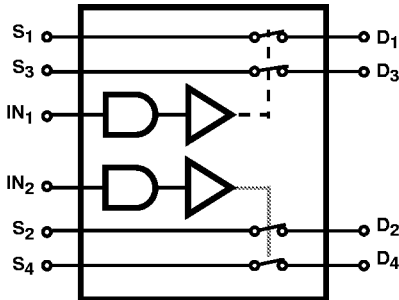


TRUTH TABLE

LOGIC	SWITCH 1	SWITCH 2
0	OFF	ON
1	ON	OFF

Logic "0"  $\leq 0.8V$ , Logic "1"  $\geq 4.0V$ ; One SPDT switch per package (switches shown for Logic "1" input).

DG302A

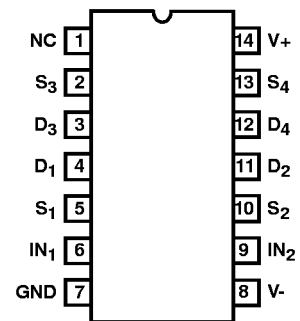


TRUTH TABLE

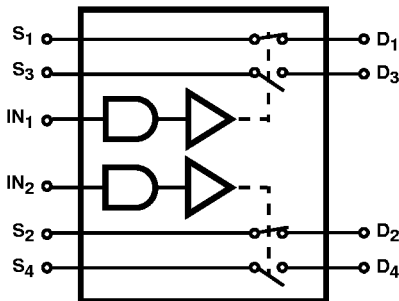
LOGIC	SWITCH
0	OFF
1	ON

Logic "0"  $\leq 0.8V$ , Logic "1"  $\geq 4.0V$ ; Two DPST switch per package (switches shown for Logic "1" input)

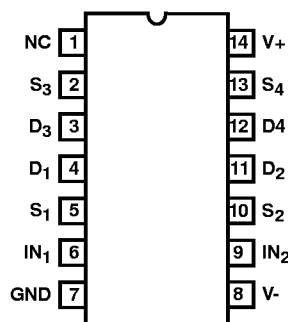
DG302A (CERDIP, PDIP)  
TOP VIEW



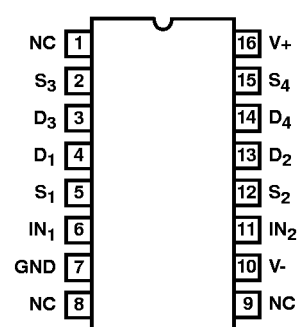
DG303A



DG303A (CERDIP, PDIP)  
TOP VIEW



DG303ACY (SOIC)  
TOP VIEW



TRUTH TABLE

LOGIC	SWITCH 1 AND 2	SWITCH 3 AND 4
0	OFF	ON
1	ON	OFF

Logic "0"  $\leq 0.8V$ , Logic "1"  $\geq 4.0V$ ; Two SPDT switch per package (switches shown for Logic "1" input)

# DG300A, DG301A, DG302A, DG303A

## Absolute Maximum Ratings

V+ to V-	+44.0V
V- to GND	-25V
V <sub>IN</sub> to Ground (Note 1)	(V- - 2V), (V+ + 2V)
V <sub>S</sub> or V <sub>D</sub> to V+ (Note 1)	+2, (V- - 2V)
V <sub>S</sub> or V <sub>D</sub> to V- (Note 1)	-2, (V+ + 2V)
Current, Any Terminal Except S or D	30mA
Continuous Current, S or D	30mA
Peak Current, S or D (Pulsed at 1ms, 10% Duty Cycle Max)	100mA

## Operating Conditions

Voltage Range	±15V
Temperature Range	
(C Suffix)	0°C to 70°C
(B Suffix)	-25°C to 85°C
(A Suffix)	-55°C to 125°C
Input Low Voltage	0.8V (Max)
Input High Voltage	4.0V (Min)
Input Rise and Fall Time	<20ns

**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### NOTES:

- Signals on V<sub>S</sub>, V<sub>D</sub> or V<sub>IN</sub> exceeding V+ or V- will be clamped by internal diodes. Limit diode toward current to maximum current ratings.
- θ<sub>JA</sub> is measured with the component mounted on an evaluation PC board in free air.

## Electrical Specifications V+ = +15V, V- = -15V, GND = 0V, T<sub>A</sub> = 25°C

PARAMETER	TEST CONDITIONS	DG300A - DG303AA			DG300A - DG303AB/C			UNITS	
		MIN	(NOTE 7) TYP	MAX	MIN	(NOTE 7) TYP	MAX		
<b>DYNAMIC CHARACTERISTICS</b>									
Turn-ON Time, t <sub>ON</sub>	See Figure 3	-	150	300	-	150	-	ns	
Turn-OFF Time, t <sub>OFF</sub>	See Figure 3	-	130	250	-	130	-	ns	
Break-Before-Make Interval, t <sub>ON</sub> - t <sub>OFF</sub>	See Figure 2, DG301A/DG303A	-	50	-	-	50	-	ns	
Charge Injection, Q	C <sub>L</sub> = 10nF, R <sub>S</sub> = 0, V <sub>S</sub> = 0	-	3	-	-	3	-	mV	
Source OFF Capacitance, C <sub>S(OFF)</sub>	f = 1MHz, V <sub>IN</sub> = 0.8V or V <sub>IN</sub> = 4.0V	V <sub>S</sub> = 0	-	14	-	-	14	-	pF
Drain OFF Capacitance, C <sub>D(OFF)</sub>		V <sub>D</sub> = 0	-	14	-	-	14	-	pF
Channel ON Capacitance, C <sub>D(ON)</sub> + C <sub>S(ON)</sub>		V <sub>S</sub> = V <sub>D</sub> = 0	-	40	-	-	40	-	pF
Input Capacitance, C <sub>IN</sub>	f = 1MHz	V <sub>IN</sub> = 0	-	6	-	-	6	-	pF
		V <sub>IN</sub> = 15V	-	7	-	-	7	-	pF
OFF Isolation (Note 9)	V <sub>IN</sub> = 0, R <sub>L</sub> = 1K, V <sub>S</sub> = 1V <sub>RMS</sub> , f = 500kHz	-	62	-	-	62	-	dB	
Crosstalk (Channel-to-Channel)		-	74	-	-	74	-	dB	
<b>INPUT</b>									
Input Current with Voltage High, I <sub>INH</sub>	V <sub>IN</sub> = 5.0V	-1	-0.001	-	-1	-0.001	-	μA	
	V <sub>IN</sub> = 15.0V	-	0.001	1	-	0.001	1	μA	
Input Current with Voltage Low, I <sub>INL</sub>	V <sub>IN</sub> = 0V	-1	-0.001	-	-1	-0.001	-	μA	
<b>ANALOG SWITCH</b>									
Analog Signal Range, V <sub>ANALOG</sub>	I <sub>S</sub> = 10mA, V <sub>IN</sub> = 0.8V or 4V	-15	-	15	-15	-	15	V	

## DG300A, DG301A, DG302A, DG303A

### Electrical Specifications $V_+ = +15V, V_- = -15V, GND = 0V, T_A = 25^\circ C$ (Continued)

PARAMETER	TEST CONDITIONS	DG300A - DG303AA			DG300A - DG303AB/C			UNITS	
		MIN	(NOTE 7) TYP	MAX	MIN	(NOTE 7) TYP	MAX		
Drain-Source ON Resistance, $r_{DS(ON)}$	$V_{IN} = 0.8V$ or $V_{IN} = 4.0V$	$I_S = -10mA, V_D = 10V$	-	30	50	-	30	50	$\Omega$
		$I_S = 10mA, V_D = -10V$	-	30	50	-	30	50	$\Omega$
Source OFF Leakage Current, $I_{S(OFF)}$	$V_{IN} = 0.8V$ or $V_{IN} = 4.0V$	$V_S = 14V, V_D = -14V$	-	0.1	1	-	0.1	5	nA
		$V_S = -14V, V_D = 14V$	-1	-0.1	-	-5	-0.1	-	nA
Drain OFF Leakage Current, $I_{D(OFF)}$	$V_{IN} = 0.8V$ or $V_{IN} = 4.0V$	$V_S = -14V, V_D = 14V$	-	0.1	1	-	0.1	5	nA
		$V_S = 14V, V_D = -14V$	-1	-0.1	-	-5	-0.1	-	nA
Drain ON Leakage Current, $I_{D(ON)}$	$V_{IN} = 0.8V$ or $V_{IN} = 4.0V$	$V_D = V_S = 14V$	-	0.1	1	-	0.1	5	nA
		$V_D = V_S = -14V$	-2	-0.1	-	-5	-0.1	-	nA
<b>POWER SUPPLIES</b>									
Positive Supply Current, $I_+$	$V_{IN} = 4V$ (One Input) (All Others = 0)	-	0.23	0.5	-	0.23	0.5	mA	
Negative Supply Current, $I_-$		-10	-0.001	-	-10	-0.001	-	$\mu A$	
Positive Supply Current, $I_+$	$V_{IN} = 0.8V$ (All Inputs)	-	0.001	10	-	0.001	10	$\mu A$	
Negative Supply Current, $I_-$		-10	-0.001	-	-10	-0.001	-	$\mu A$	

### Electrical Specifications $V_+ = +15V, V_- = -15V, GND = 0V, T_A =$ Over Temperature Range

PARAMETER	TEST CONDITION	DG300A - DG303AA			DG300A - DG303AB/C			UNITS	
		MIN	(NOTE 7) TYP	MAX	MIN	(NOTE 7) TYP	MAX		
<b>INPUT</b>									
Input Current with Voltage High, $I_{INH}$	$V_{IN} = 5.0V$	-1	-	-	-	-	-	$\mu A$	
	$V_{IN} = 15.0V$	-	-	1	-	-	-	$\mu A$	
Input Current with Voltage Low, $I_{INL}$	$V_{IN} = 0V$	-1	-	-	-	-	-	$\mu A$	
<b>ANALOG SWITCH</b>									
Analog Signal Range, $V_{ANALOG}$	$I_S = 10mA, V_{IN} = 0.8V$ or $4V$	-15	-	15	-	-	-	V	
Drain-Source ON Resistance, $r_{DS(ON)}$	$V_{IN} = 0.8V$ or $V_{IN} = 4.0V$	$I_S = -10mA, V_D = 10V$	-	-	75	-	-	-	$\Omega$
		$I_S = 10mA, V_D = -10V$	-	-	75	-	-	-	$\Omega$
Source OFF Leakage Current, $I_{S(OFF)}$	$V_{IN} = 0.8V$ or $V_{IN} = 4.0V$	$V_S = 14V, V_D = -14V$	-	-	100	-	-	-	nA
		$V_S = -14V, V_D = 14V$	-100	-	-	-	-	-	nA
Drain OFF Leakage Current, $I_{D(OFF)}$	$V_{IN} = 0.8V$ or $V_{IN} = 4.0V$	$V_S = -14V, V_D = 14V$	-	-	100	-	-	-	nA
		$V_S = 14V, V_D = -14V$	-100	-	-	-	-	-	nA
Drain ON Leakage Current, $I_{D(ON)}$	$V_{IN} = 0.8V$ or $V_{IN} = 4.0V$	$V_D = V_S = 14V$	-	-	100	-	-	-	nA
		$V_D = V_S = -14V$	-200	-	-	-	-	-	nA

## DG300A, DG301A, DG302A, DG303A

### Electrical Specifications $V_+ = +15V$ , $V_- = -15V$ , $GND = 0V$ , $T_A =$ Over Temperature Range (Continued)

PARAMETER	TEST CONDITION	DG300A - DG303AA			DG300A - DG303AB/C			UNITS
		MIN	(NOTE 7) TYP	MAX	MIN	(NOTE 7) TYP	MAX	
<b>POWER SUPPLIES</b>								
Positive Supply Current, $I_+$	$V_{IN} = 4V$ (One Input) (All Others = 0)	-	-	1	-	-	-	mA
Negative Supply Current, $I_-$		-100	-	-	-	-	-	$\mu A$
Positive Supply Current, $I_+$	$V_{IN} = 0.8V$ (All Inputs)	-	-	100	-	-	-	$\mu A$
Negative Supply Current, $I_-$		-100	-	-	-	-	-	$\mu A$

**NOTES:**

3. Device mounted with all leads soldered or welded to PC board.
4. Derate  $11mW/^\circ C$  above  $75^\circ C$
5. Derate  $6.5mW/^\circ C$  above  $25^\circ C$ .
6. Derate  $6mW/^\circ C$  above  $75^\circ C$ .
7. For design only, not 100% tested.
8. The algebraic convention whereby the most negative value is a minimum, and the most positive value is a maximum, is used in this data sheet.
9. OFF isolation =  $20 \text{ Log } V_S/V_D$ , where  $V_S$  = input to OFF switch, and  $V_D$  = output.

### Pin Descriptions

PIN	SYMBOL	DESCRIPTION
<b>DG300A</b>		
1	NC	No Connection
2	$D_1$	Drain (Output) Terminal for Switch 1
3	NC	No Connection
4	$S_1$	Source (Input) Terminal for Switch 1
5	NC	No Connection
6	$IN_1$	Logic Control for Switch 1
7	GND	Ground Terminal (Logic Common)
8	$V_-$	Negative Power Supply Terminal
9	$IN_2$	Logic Control for Switch 2
10	NC	No Connection
11	NC	No Connection
12	$S_2$	Source (Input) Terminal for Switch 2
13	$D_2$	Drain (Output) Terminal for Switch 2
14	$V_+$	Positive Power Supply Terminal
<b>DG301A</b>		
1	NC	No Connection
2	$D_1$	Drain (Output) Terminal for Switch 1
3	NC	No Connection
4	$S_1$	Source (Input) Terminal for Switch 1
5	IN	Logic Control for Switches
6	GND	Ground Terminal (Logic Common)
7	$V_-$	Negative Power Supply Terminal

PIN	SYMBOL	DESCRIPTION
8	NC	No Connection
9	NC	No Connection
10	$S_2$	Source (Input) Terminal for Switch 2
11	NC	No Connection
12	$D_2$	Drain (Output) Terminal for Switch 2
13	NC	No Connection
14	$V_+$	Positive Power Supply Terminal
<b>DG302A, DG303A</b>		
1	NC	No Connection
2	$S_3$	Source (Input) Terminal for Switch 3
3	$D_3$	Drain (Output) Terminal for Switch 3
4	$D_1$	Drain (Output) Terminal for Switch 1
5	$S_1$	Source (Input) Terminal for Switch 1
6	$IN_1$	Logic Control for Switch 1
7	GND	Ground Terminal (Logic Common)
8	$V_-$	Negative Power Supply Terminal
9	$IN_2$	Logic Control for Switch 2
10	$S_2$	Source (Input) Terminal for Switch 2
11	$D_2$	Drain (Output) Terminal for Switch 2
12	$D_4$	Drain (Output) Terminal for Switch 4
13	$S_4$	Source (Input) Terminal for Switch 4
14	$V_+$	Positive Power Supply Terminal

Test Circuits and Waveforms

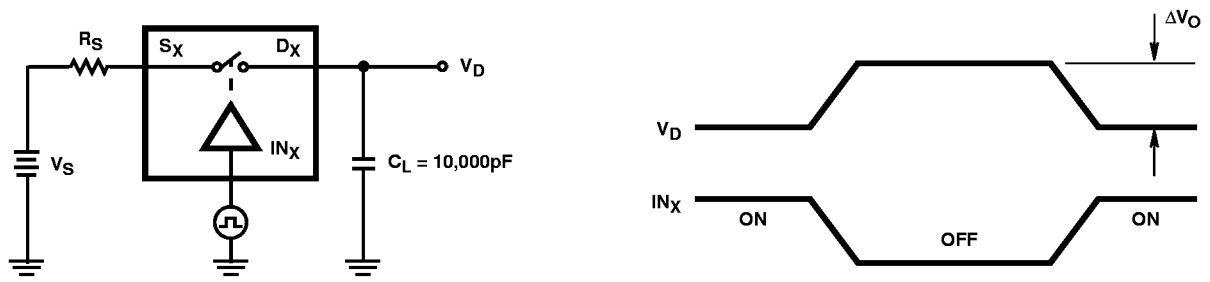


FIGURE 1. CHARGE INJECTION TEST CIRCUIT

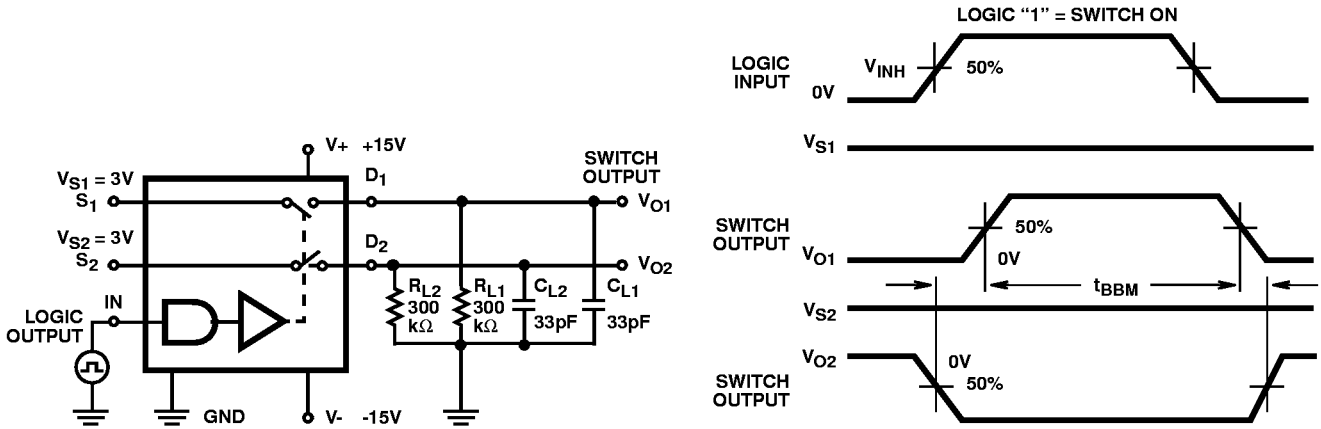


FIGURE 2. BREAK-BEFORE MAKE TEST CIRCUIT (DG301A, DG303A)

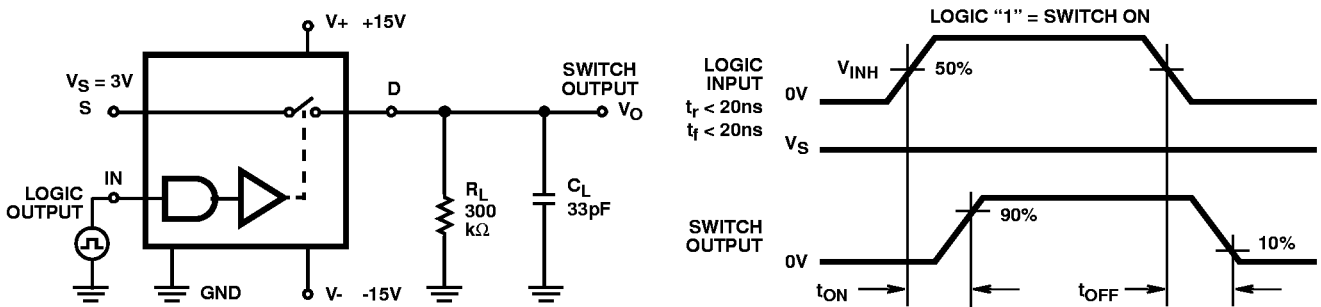


FIGURE 3.  $t_{ON}$  and  $t_{OFF}$  TEST CIRCUIT

# DG300A, DG301A, DG302A, DG303A

## Die Characteristics

### DIE DIMENSIONS:

89 mils x 99 mils x 12 mils  $\pm 2$  mils

### METALLIZATION:

Type: Al

Thickness:  $10\text{k}\text{\AA} \pm 1\text{k}\text{\AA}$

### PASSIVATION:

Type: PSG Over Nitride

PSG Thickness:  $7\text{k}\text{\AA} \pm 1.4\text{k}\text{\AA}$

Nitride Thickness:  $8\text{k}\text{\AA} \pm 1.2\text{k}\text{\AA}$

### WORST CASE CURRENT DENSITY:

$1 \times 10^5 \text{ A/cm}^2$

## Metallization Mask Layouts

