

## TTL-Compatible, CMOS Analog Switches

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<sub>P-P</sub> 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.

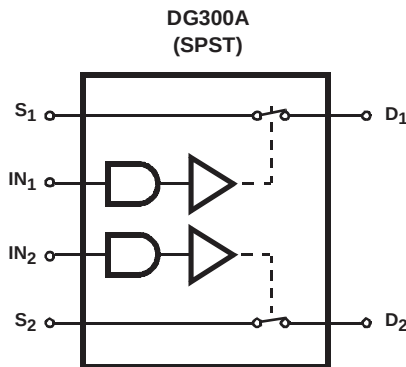
## Features

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

## Part Number Information

| PART NUMBER | TEMP. RANGE (°C) | PACKAGE      | PKG. NO. |
|-------------|------------------|--------------|----------|
| DG300ABK    | -25 to 85        | 14 Ld Cerdip | F14.3    |
| DG301ACJ    | 0 to 70          | 14 Ld PDIP   | E14.3    |
| DG303AAK    | -55 to 125       | 14 Ld Cerdip | F14.3    |
| DG303ABK    | -25 to 85        | 14 Ld Cerdip | F14.3    |
| DG303ACJ    | 0 to 70          | 14 Ld PDIP   | E14.3    |
| DG303ACY    | 0 to 70          | 16 Ld SOIC   | M16.3    |

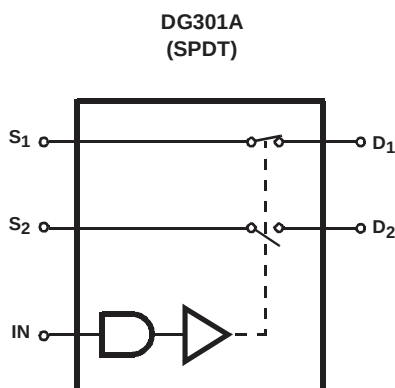
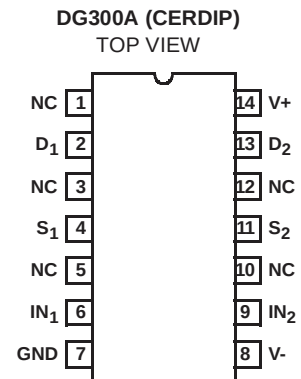
## Functional Diagrams and Pinouts (Switches shown for a logic "1" input)



**DG300A TRUTH TABLE**

| LOGIC | SWITCH |
|-------|--------|
| 0     | OFF    |
| 1     | ON     |

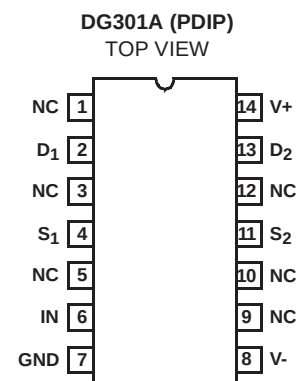
Logic "0"  $\leq$  0.8V, Logic "1"  $\geq$  4.0V.



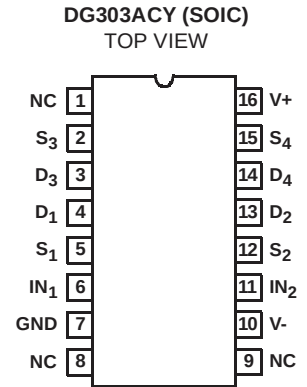
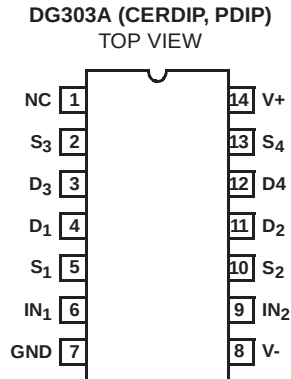
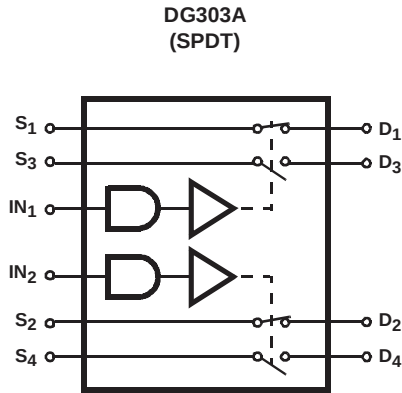
**DG301A TRUTH TABLE**

| LOGIC | SWITCH 1 | SWITCH 2 |
|-------|----------|----------|
| 0     | OFF      | ON       |
| 1     | ON       | OFF      |

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



**Functional Diagrams and Pinouts** (Switches shown for a logic "1" input) (Continued)



**DG303A TRUTH TABLE**

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

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

**Pin Descriptions**

| PIN           | SYMBOL          | DESCRIPTION                          |
|---------------|-----------------|--------------------------------------|
| <b>DG300A</b> |                 |                                      |
| 1             | NC              | No Connection                        |
| 2             | D <sub>1</sub>  | Drain (Output) Terminal for Switch 1 |
| 3             | NC              | No Connection                        |
| 4             | S <sub>1</sub>  | Source (Input) Terminal for Switch 1 |
| 5             | NC              | No Connection                        |
| 6             | IN <sub>1</sub> | Logic Control for Switch 1           |
| 7             | GND             | Ground Terminal (Logic Common)       |
| 8             | V-              | Negative Power Supply Terminal       |
| 9             | IN <sub>2</sub> | Logic Control for Switch 2           |
| 10            | NC              | No Connection                        |
| 11            | NC              | No Connection                        |
| 12            | S <sub>2</sub>  | Source (Input) Terminal for Switch 2 |
| 13            | D <sub>2</sub>  | Drain (Output) Terminal for Switch 2 |
| 14            | V+              | Positive Power Supply Terminal       |
| <b>DG301A</b> |                 |                                      |
| 1             | NC              | No Connection                        |
| 2             | D <sub>1</sub>  | Drain (Output) Terminal for Switch 1 |
| 3             | NC              | No Connection                        |
| 4             | S <sub>1</sub>  | 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 <sub>2</sub>  | Source (Input) Terminal for Switch 2 |
| 11            | NC              | No Connection                        |
| 12            | D <sub>2</sub>  | Drain (Output) Terminal for Switch 2 |
| 13            | NC              | No Connection                        |
| 14            | V+              | Positive Power Supply Terminal       |
| <b>DG303A</b> |                 |                                      |
| 1             | NC              | No Connection                        |
| 2             | S <sub>3</sub>  | Source (Input) Terminal for Switch 3 |
| 3             | D <sub>3</sub>  | Drain (Output) Terminal for Switch 3 |
| 4             | D <sub>1</sub>  | Drain (Output) Terminal for Switch 1 |
| 5             | S <sub>1</sub>  | Source (Input) Terminal for Switch 1 |
| 6             | IN <sub>1</sub> | Logic Control for Switch 1           |
| 7             | GND             | Ground Terminal (Logic Common)       |
| 8             | V-              | Negative Power Supply Terminal       |
| 9             | IN <sub>2</sub> | Logic Control for Switch 2           |
| 10            | S <sub>2</sub>  | Source (Input) Terminal for Switch 2 |
| 11            | D <sub>2</sub>  | Drain (Output) Terminal for Switch 2 |
| 12            | D <sub>4</sub>  | Drain (Output) Terminal for Switch 4 |
| 13            | S <sub>4</sub>  | Source (Input) Terminal for Switch 4 |
| 14            | V+              | Positive Power Supply Terminal       |

## Absolute Maximum Ratings

|                                                                   |                                                           |
|-------------------------------------------------------------------|-----------------------------------------------------------|
| V+ to V- . . . . .                                                | 44.0V                                                     |
| V- to GND. . . . .                                                | 25V                                                       |
| Digital Inputs, V <sub>S</sub> , V <sub>D</sub> (Note 1). . . . . | (V-) - 2V to (V+) + 2V<br>or 30mA, Whichever Occurs First |
| Continuous Current, (Any Terminal). . . . .                       | 30mA                                                      |
| Peak Current, S or D (Pulsed 1ms, 10% Duty Cycle Max) . .         | 100mA                                                     |

## Operating Conditions

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

## Thermal Information

|                                                    |                        |                                  |
|----------------------------------------------------|------------------------|----------------------------------|
| Thermal Resistance (Typical, Note 2)               | θ <sub>JA</sub> (°C/W) | θ <sub>JC</sub> (°C/W)           |
| SOIC Package . . . . .                             | 100                    | N/A                              |
| PDIP Package . . . . .                             | 100                    | N/A                              |
| CERDIP Package. . . . .                            | 75                     | 20                               |
| Maximum Junction Temperature                       |                        |                                  |
| Hermetic Packages . . . . .                        |                        | 175°C                            |
| Plastic Packages . . . . .                         |                        | 150°C                            |
| Maximum Storage Temperature Range. . . . .         |                        | -65°C to 150°C                   |
| Maximum Lead Temperature (Soldering, 10s). . . . . |                        | 300°C<br>(SOIC - Lead Tips Only) |

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:

1. Signals on S<sub>X</sub>, D<sub>X</sub> or I<sub>NX</sub> exceeding V+ or V- will be clamped by internal diodes. Limit diode forward current to maximum current ratings.
2. 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                                                                               |                                     | “A” SUFFIX |                 |     | “B” AND “C” SUFFIX |                 |     | UNITS |
|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------------------------------|------------|-----------------|-----|--------------------|-----------------|-----|-------|
|                                                                 |                                                                                               |                                     | MIN        | (NOTE 3)<br>TYP | MAX | MIN                | (NOTE 3)<br>TYP | MAX |       |
| DYNAMIC CHARACTERISTICS                                         |                                                                                               |                                     |            |                 |     |                    |                 |     |       |
| 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>D</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    |
| OFF Isolation (Note 4)                                          | V <sub>IN</sub> = 0, R <sub>L</sub> = 1kΩ, V <sub>S</sub> = 1V <sub>RMS</sub> ,<br>f = 500kHz |                                     | -          | 62              | -   | -                  | 62              | -   | dB    |
| Crosstalk<br>(Channel-to-Channel)                               |                                                                                               |                                     | -          | -74             | -   | -                  | -74             | -   | dB    |
| Source OFF Capacitance, C <sub>S(OFF)</sub>                     | f = 1MHz,<br>V <sub>IN</sub> = 0.8V or<br>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    |
| DIGITAL INPUT CHARACTERISTICS                                   |                                                                                               |                                     |            |                 |     |                    |                 |     |       |
| Input Current with Voltage High, I <sub>IH</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>IL</sub>                 | V <sub>IN</sub> = 0V                                                                          |                                     | -1         | -0.001          | -   | -1                 | -0.001          | -   | μA    |

# DG300A, DG301A, DG303A

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

| PARAMETER                                | TEST CONDITIONS                               |                             | “A” SUFFIX |                 |     | “B” AND “C” SUFFIX |                 |     | UNITS    |
|------------------------------------------|-----------------------------------------------|-----------------------------|------------|-----------------|-----|--------------------|-----------------|-----|----------|
|                                          |                                               |                             | MIN        | (NOTE 3)<br>TYP | MAX | MIN                | (NOTE 3)<br>TYP | MAX |          |
| ANALOG SWITCH CHARACTERISTICS            |                                               |                             |            |                 |     |                    |                 |     |          |
| Analog Signal Range, $V_{ANALOG}$        | $I_S = 10mA$ , $V_{IN} = 0.8V$ or $4V$        |                             | -15        | -               | 15  | -15                | -               | 15  | V        |
| Drain-Source ON Resistance, $r_{DS(ON)}$ | $V_{IN} = 0.8V$ or $V_{IN} = 4.0V$            | $I_S = -10mA$ , $V_D = 10V$ | -          | 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       |
| Channel 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       |
| POWER SUPPLY CHARACTERISTICS             |                                               |                             |            |                 |     |                    |                 |     |          |
| Positive Supply Current, $I_+$           | $V_{IN} = 4V$ (One Input)<br>(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 $V_+ = +15V$ , $V_- = -15V$ , $GND = 0V$ , $T_A = \text{Full Temperature Range}$

| PARAMETER                                        | TEST CONDITION                                      |                                              | “A” SUFFIX |                 |     | “B” AND “C” SUFFIX |                 |     | UNITS |
|--------------------------------------------------|-----------------------------------------------------|----------------------------------------------|------------|-----------------|-----|--------------------|-----------------|-----|-------|
|                                                  |                                                     |                                              | MIN        | (NOTE 3)<br>TYP | MAX | MIN                | (NOTE 3)<br>TYP | MAX |       |
| DIGITAL INPUT CHARACTERISTICS                    |                                                     |                                              |            |                 |     |                    |                 |     |       |
| Input Current with Voltage High, I <sub>IH</sub> | V <sub>IN</sub> = 5.0V                              |                                              | -1         | -               | -   | -                  | -               | -   | μA    |
|                                                  | V <sub>IN</sub> = 15.0V                             |                                              | -          | -               | 1   | -                  | -               | -   | μA    |
| Input Current with Voltage Low, I <sub>IL</sub>  | V <sub>IN</sub> = 0V                                |                                              | -1         | -               | -   | -                  | -               | -   | μA    |
| ANALOG SWITCH CHARACTERISTICS                    |                                                     |                                              |            |                 |     |                    |                 |     |       |
| Analog Signal Range, V <sub>ANALOG</sub>         | I <sub>S</sub> = 10mA, V <sub>IN</sub> = 0.8V or 4V |                                              | -15        | -               | 15  | -                  | -               | -   | V     |
| Drain-Source ON Resistance, r <sub>DS(ON)</sub>  | V <sub>IN</sub> = 0.8V or V <sub>IN</sub> = 4.0V    | I <sub>S</sub> = -10mA, V <sub>D</sub> = 10V | -          | -               | 75  | -                  | -               | -   | Ω     |
|                                                  |                                                     | I <sub>S</sub> = 10mA, V <sub>D</sub> = -10V | -          | -               | 75  | -                  | -               | -   | Ω     |
| Source OFF Leakage Current, I <sub>S(OFF)</sub>  | V <sub>IN</sub> = 0.8V or V <sub>IN</sub> = 4.0V    | V <sub>S</sub> = 14V, V <sub>D</sub> = -14V  | -          | -               | 100 | -                  | -               | -   | nA    |
|                                                  |                                                     | V <sub>S</sub> = -14V, V <sub>D</sub> = 14V  | -100       | -               | -   | -                  | -               | -   | nA    |

**Electrical Specifications**  $V_+ = +15V$ ,  $V_- = -15V$ ,  $GND = 0V$ ,  $T_A = \text{Full Temperature Range}$  (Continued)

| PARAMETER                                      | TEST CONDITION                                       |                                                | “A” SUFFIX |                 |     | “B” AND “C” SUFFIX |                 |     | UNITS |
|------------------------------------------------|------------------------------------------------------|------------------------------------------------|------------|-----------------|-----|--------------------|-----------------|-----|-------|
|                                                |                                                      |                                                | MIN        | (NOTE 3)<br>TYP | MAX | MIN                | (NOTE 3)<br>TYP | MAX |       |
| Drain OFF Leakage Current, I <sub>D(OFF)</sub> | V <sub>IN</sub> = 0.8V or<br>V <sub>IN</sub> = 4.0V  | V <sub>S</sub> = -14V,<br>V <sub>D</sub> = 14V | -          | -               | 100 | -                  | -               | -   | nA    |
|                                                |                                                      | V <sub>S</sub> = 14V,<br>V <sub>D</sub> = -14V | -100       | -               | -   | -                  | -               | -   | nA    |
| Channel ON Leakage Current, I <sub>D(ON)</sub> | V <sub>IN</sub> = 0.8V or<br>V <sub>IN</sub> = 4.0V  | V <sub>D</sub> = V <sub>S</sub> = 14V          | -          | -               | 100 | -                  | -               | -   | nA    |
|                                                |                                                      | V <sub>D</sub> = V <sub>S</sub> = -14V         | -200       | -               | -   | -                  | -               | -   | nA    |
| POWER SUPPLY CHARACTERISTICS                   |                                                      |                                                |            |                 |     |                    |                 |     |       |
| Positive Supply Current, I <sub>+</sub>        | V <sub>IN</sub> = 4V (One Input)<br>(All Others = 0) |                                                | -          | -               | 1   | -                  | -               | -   | mA    |
| Negative Supply Current, I <sub>-</sub>        |                                                      |                                                | -100       | -               | -   | -                  | -               | -   | μA    |
| Positive Supply Current, I <sub>+</sub>        | V <sub>IN</sub> = 0.8V (All Inputs)                  |                                                | -          | -               | 100 | -                  | -               | -   | μA    |
| Negative Supply Current, I <sub>-</sub>        |                                                      |                                                | -100       | -               | -   | -                  | -               | -   | μA    |

NOTES:

- For design only, not 100% tested.
- OFF isolation =  $20 \log V_S/V_D$ , where  $V_S$  = input to OFF switch, and  $V_D$  = output.

**Test Circuits and Waveforms**

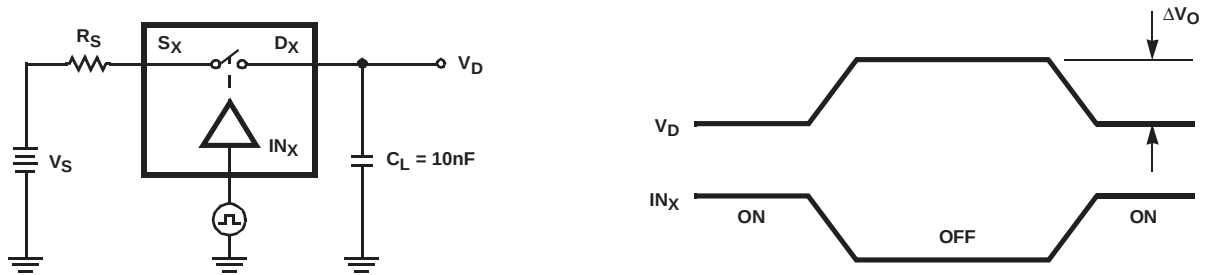


FIGURE 1. CHARGE INJECTION TEST CIRCUIT AND MEASUREMENT POINTS

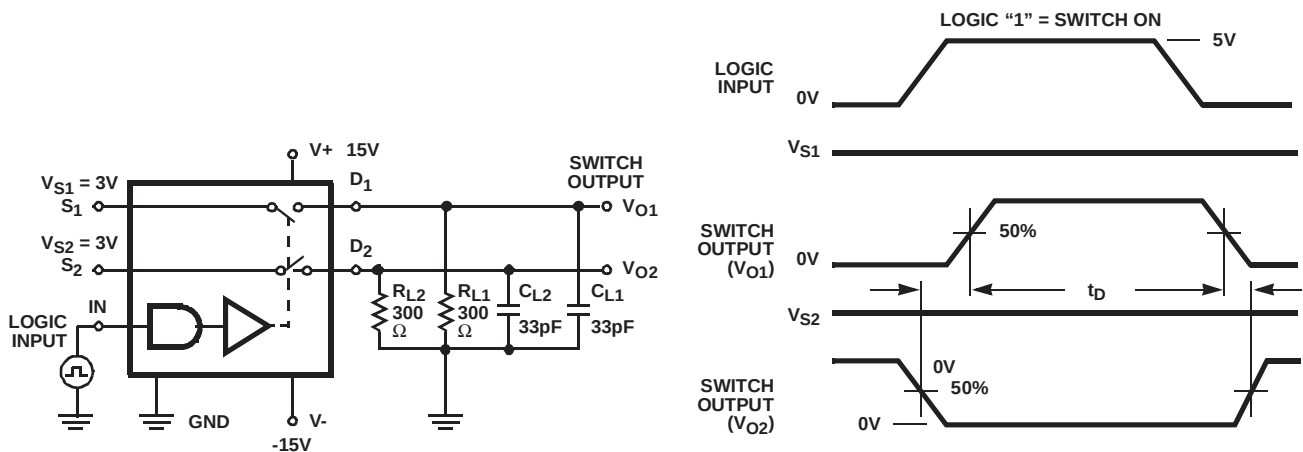


FIGURE 2. BREAK-BEFORE MAKE TEST CIRCUIT AND MEASUREMENT POINTS (DG301A, DG303A)

## Test Circuits and Waveforms (Continued)

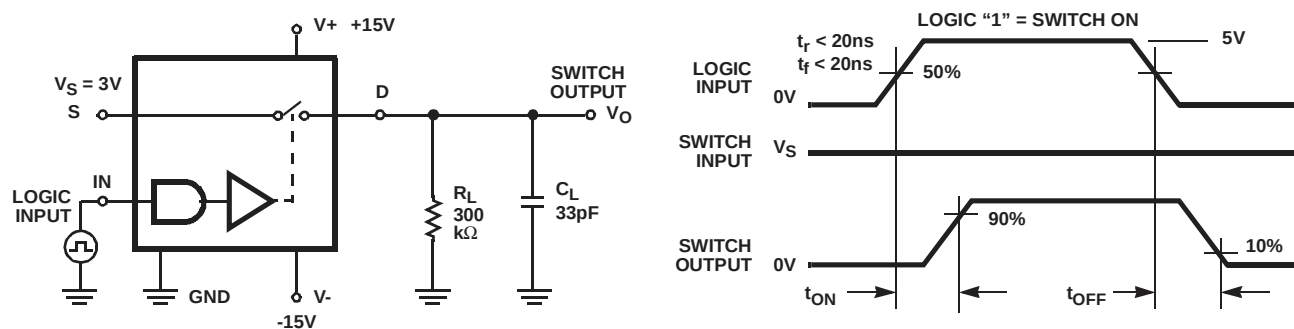


FIGURE 3.  $t_{ON}$  and  $t_{OFF}$  TEST CIRCUIT AND MEASUREMENT POINTS

## Die Characteristics

### DIE DIMENSIONS:

89 mils x 99 mils x 12 mils

### METALLIZATION:

Type: Al

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

### PASSIVATION:

Type: PSG Over Nitride

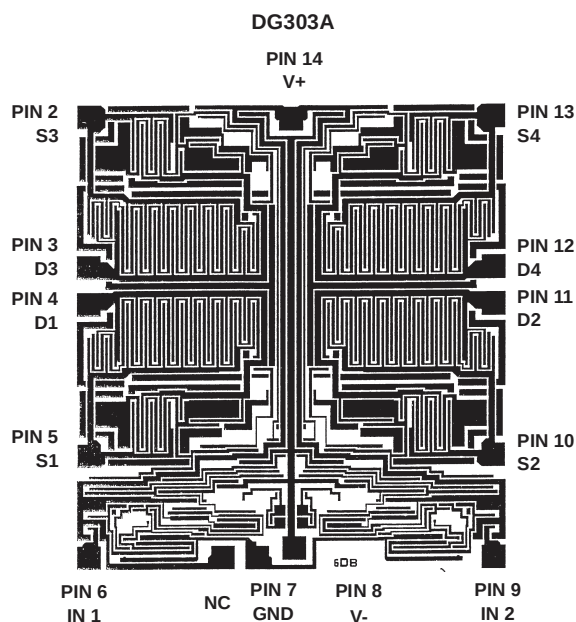
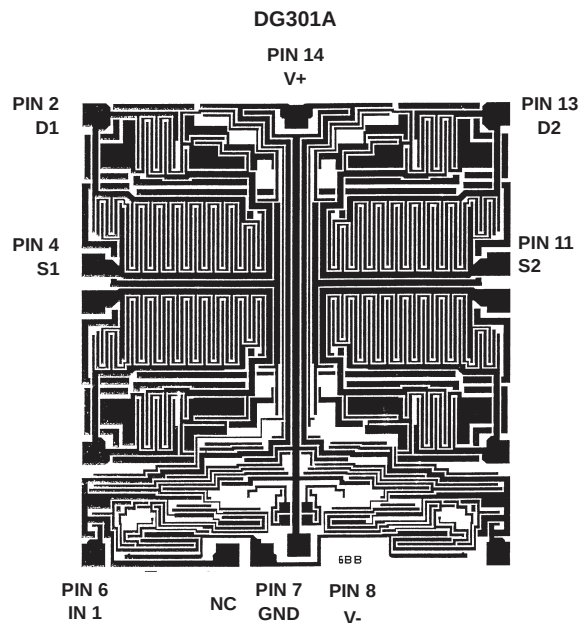
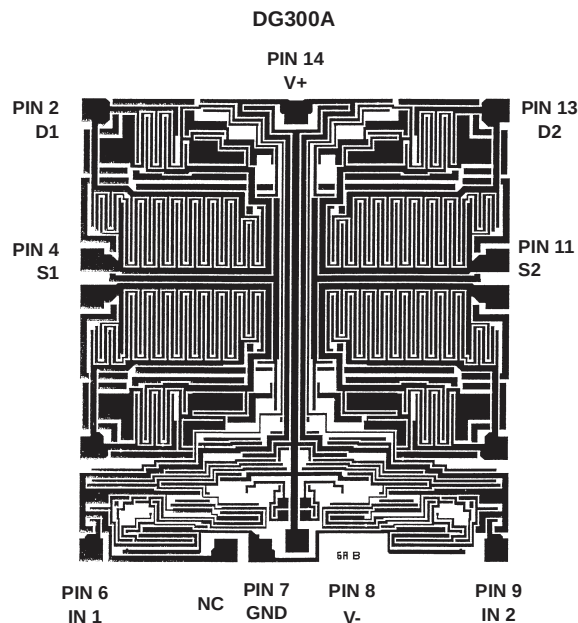
PSG Thickness:  $7\text{k}\text{\AA} \pm 1.4\text{k}\text{\AA}$

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



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