



# Quad, SPST Analog Switches

DG308A/DG309

## General Description

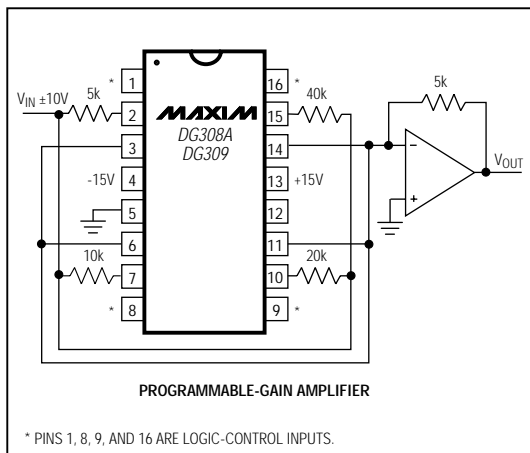
The DG308A/DG309 are quad, single-pole-single-throw (SPST) analog switches. The DG308A is normally open (SPST, NO), while the DG309 is normally closed (SPST, NC). Both parts feature fast switching speeds and low on-resistance over the analog range. Other features include a turn-on time under 120ns, a turn-off time under 90ns, and a channel on-resistance of 60Ω. CMOS inputs provide reduced input loading and very low leakage currents.

Both parts feature a 44V maximum breakdown voltage rating that allows 30V peak-to-peak switch-off blocking capacity. The DG308A/DG309 can be used with split supplies (±5V to ±20V) or a single positive supply (+5V to +30V), while retaining CMOS-logic-compatible inputs.

## Applications

- Sample-and-Hold Circuits
- Test Equipment
- Communications Systems
- PBX, PABX
- Guidance and Control Systems
- Heads-Up Displays
- Military Radios

## Typical Operating Circuit



## Features

- ◆ 60Ω  $r_{DS(ON)}$
- ◆ Single/Bipolar-Supply Operation
- ◆ CMOS Logic Compatible
- ◆ Monolithic, Low-Power CMOS Design

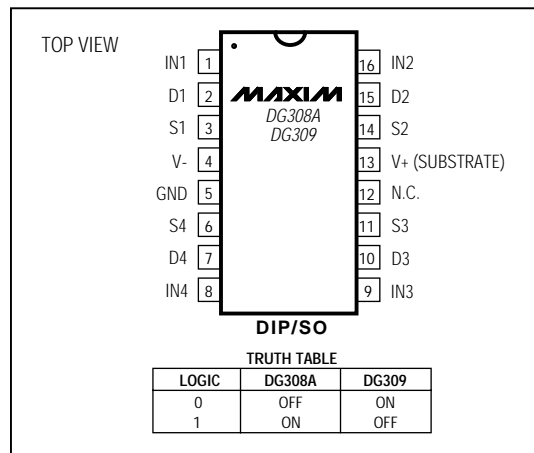
## Ordering Information

| PART      | TEMP. RANGE     | PIN-PACKAGE    |
|-----------|-----------------|----------------|
| DG308ACJ  | 0°C to +70°C    | 16 Plastic DIP |
| DG308ACY  | 0°C to +70°C    | 16 Narrow SO   |
| DG308ACK  | 0°C to +70°C    | 16 CERDIP      |
| DG308AC/D | 0°C to +70°C    | Dice*          |
| DG308ADJ  | -40°C to +85°C  | 16 Plastic DIP |
| DG308ADY  | -40°C to +85°C  | 16 Narrow SO   |
| DG308ADK  | -40°C to +85°C  | 16 CERDIP      |
| DG308AAK  | -55°C to +125°C | 16 CERDIP**    |
| DG309CJ   | 0°C to +70°C    | 16 Plastic DIP |
| DG309CY   | 0°C to +70°C    | 16 Narrow SO   |
| DG309CK   | 0°C to +70°C    | 16 CERDIP      |
| DG309C/D  | 0°C to +70°C    | Dice*          |
| DG309DJ   | -40°C to +85°C  | 16 Plastic DIP |
| DG309DY   | -40°C to +85°C  | 16 Narrow SO   |
| DG309DK   | -40°C to +85°C  | 16 CERDIP      |
| DG309AK   | -55°C to +125°C | 16 CERDIP**    |

\* Contact factory for dice specifications.

\*\* Contact factory for availability and processing to MIL-STD-883.

## Pin Configuration/Truth Table



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## ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to V-

V+ .....+44V

GND .....+25V

Digital Inputs V<sub>S</sub>, V<sub>D</sub>.....(V- - 2V) to (V+ + 2V) or 20mA, whichever occurs first

Current into Any Terminal (except S or D) .....30mA

Continuous Current (S or D) .....20mA

Peak Current (S or D) .....70mA (pulsed at 1ms, 10% duty cycle max)

Continuous Power Dissipation (T<sub>A</sub> = +70°C) (Note 1)

Plastic DIP (derate 10.53mW/°C above +70°C) .....842mW

Narrow SO (derate 8.70mW/°C above +70°C) .....696mW

CERDIP (derate 10.00mW/°C above +70°C) .....800mW

Operating Temperature Ranges

DG308AC\_/DG309C\_ .....0°C to +70°C

DG308AD\_/DG309D\_ .....-40°C to +85°C

DG308AAK/DG309AK .....-55°C to +125°C

Storage Temperature Range .....-65°C to +150°C

Lead Temperature (soldering, 10sec) .....+300°C

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.

## ELECTRICAL CHARACTERISTICS

(V<sub>+</sub> = 15V, V<sub>-</sub> = -15V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted.) (Note 2)

| PARAMETER                             | SYMBOL              | CONDITIONS   | DG30_AK                                  |      |        | DG30_C/D |      |       | UNITS |    |
|---------------------------------------|---------------------|--|--|------|--------|----------|------|-------|-------|----|
|                                       |                     |  | MIN                                      | TYP  | MAX    | MIN      | TYP  | MAX   |       |    |
| <b>SWITCH</b>                         |                     |  |  |      |        |          |      |       |       |    |
| Analog Signal Range                   | V <sub>ANALOG</sub> |  | T <sub>A</sub> = +25°C                   | -15  |        | 15       | -15  |       | 15    | V  |
| Drain-Source On-Resistance            | r <sub>DS(ON)</sub> | V <sub>IN</sub> = 11V (DG308A), V <sub>IN</sub> = 3.5V (DG309), I <sub>S</sub> = 1mA, V <sub>D</sub> = 10V or -10V | T <sub>A</sub> = +25°C, T <sub>MIN</sub> |      | 60     | 100      |      | 60    | 100   | Ω  |
|                                       |                     |  | T <sub>A</sub> = T <sub>MAX</sub>        |      | 95     | 150      |      | 80    | 125   |    |
| Source-Off Leakage Current            | I <sub>S(OFF)</sub> | V <sub>IN</sub> = 3.5V (DG308A), V <sub>IN</sub> = 11V (DG309), V <sub>S</sub> = 14V, V <sub>D</sub> = -14V        | T <sub>A</sub> = +25°C                   | -1   | 0.1    | 1        | -5   | 0.1   | 5     | nA |
|                                       |                     |  | T <sub>A</sub> = T <sub>MAX</sub>        | -100 |        | 100      | -100 |       | 100   |    |
|                                       |                     |  | T <sub>A</sub> = +25°C                   | -1   | -0.1   | 1        | -5   | 0.1   | 5     |    |
|                                       |                     |  | T <sub>A</sub> = T <sub>MAX</sub>        | -100 |        | 100      | -100 |       | 100   |    |
| Drain-Off Leakage Current             | I <sub>D(OFF)</sub> | V <sub>IN</sub> = 3.5V (DG308A), V <sub>IN</sub> = 11V (DG309), V <sub>S</sub> = 14V, V <sub>D</sub> = -14V        | T <sub>A</sub> = +25°C                   | -1   | 0.1    | 1        | -5   | 0.1   | 5     | nA |
|                                       |                     |  | T <sub>A</sub> = T <sub>MAX</sub>        | -100 |        | 100      | -100 |       | 100   |    |
|                                       |                     |  | T <sub>A</sub> = +25°C                   | -1   | 0.1    | 1        | -5   | 0.1   | 5     |    |
|                                       |                     |  | T <sub>A</sub> = T <sub>MAX</sub>        | -100 |        | 100      | -100 |       | 100   |    |
| Drain-On Leakage Current              | I <sub>D(ON)</sub>  | V <sub>IN</sub> = 11V (DG308A), V <sub>IN</sub> = 3.5V (DG309), V <sub>S</sub> = V <sub>D</sub> = +14V             | T <sub>A</sub> = +25°C                   | -2   | 0.1    | 2        | -5   | 0.1   | 5     | nA |
|                                       |                     |  | T <sub>A</sub> = T <sub>MAX</sub>        | -200 |        | 200      | -200 |       | 200   |    |
|                                       |                     |  | T <sub>A</sub> = +25°C                   | -2   | 0.1    | 2        | -5   | 0.1   | 5     |    |
|                                       |                     |  | T <sub>A</sub> = T <sub>MAX</sub>        | -200 |        | 200      | -200 |       | 200   |    |
| <b>INPUT</b>                          |                     |  |  |      |        |          |      |       |       |    |
| Input Current with Input Voltage High | I <sub>INH</sub>    | V <sub>IN</sub> = 15V  | T <sub>A</sub> = +25°C, T <sub>MAX</sub> | -1   | 0.001  | 1        | -1   | 0.001 | 1     | μA |
| Input Current with Input Voltage Low  | I <sub>INL</sub>    | V <sub>IN</sub> = 0V   | T <sub>A</sub> = +25°C, T <sub>MAX</sub> | -1   | -0.001 | 1        | -1   | 0.001 | 1     | μA |

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DG308A/DG309

## ELECTRICAL CHARACTERISTICS (continued)

( $V_+ = 15V$ ,  $V_- = -15V$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted.) (Note 2)

| PARAMETER               | SYMBOL                  | CONDITIONS   | DG30_AK             |      |        | DG30_C/D |      |        | UNITS |         |
|-------------------------|-------------------------|--|---------------------|------|--------|----------|------|--------|-------|---------|
|                         |                         |  | MIN                 | TYP  | MAX    | MIN      | TYP  | MAX    |       |         |
| <b>SUPPLY</b>           |                         |  |                     |      |        |          |      |        |       |         |
| Positive Supply Current | I+                      | All channels on or off, $V_{IN} = 0V$ or $15V$   | $T_A = +25^\circ C$ | -10  | 0.001  | 10       | -100 | 0.001  | 100   | $\mu A$ |
|                         |                         |  | $T_A = T_{MAX}$     |      |        | 100      |      | 100    |       |         |
| Negative Supply Current | I-                      | All channels on or off, $V_{IN} = 0V$ or $15V$   | $T_A = +25^\circ C$ | -10  | -0.001 | 10       | -100 | -0.001 | 100   | $\mu A$ |
|                         |                         |  | $T_A = T_{MAX}$     | -100 |        |          | -100 |        |       |         |
| <b>DYNAMIC</b>          |                         |  |                     |      |        |          |      |        |       |         |
| Turn-On Time            | $t_{ON}$                | Figure 1   |                     | 130  | 200    |          | 130  | 200    | ns    |         |
| Turn-Off Time           | $t_{OFF}$               | Figure 1   |                     | 90   | 150    |          | 90   | 150    | ns    |         |
| Charge Injection        | Q                       | $C_L = 0.01\mu F$ , $V_{GEN} = 0V$ , $R_{GEN} = 0\Omega$   |                     | -10  |        |          | -10  |        | pC    |         |
| Off Isolation (Note 3)  | OIRR                    | $V_{IN} = 0V$ (DG308A), $V_{IN} = 15V$ (DG309), $Z_L = 75\Omega$ , $V_S = 2V_{p-p}$ , $f = 500kHz$ |                     | 78   |        |          | 78   |        | dB    |         |
| Source-Off Capacitance  | $C_{S(OFF)}$            | $V_{IN} = 0V$ (DG308A), $V_{IN} = 15V$ (DG309), $f = 140kHz$ , $V_S = 0V$                          |                     | 11   |        |          | 11   |        | pF    |         |
| Drain-Off Capacitance   | $C_{D(OFF)}$            | $V_{IN} = 0V$ (DG308A), $V_{IN} = 15V$ (DG309), $f = 140kHz$ , $V_S = 0V$                          |                     | 8    |        |          | 8    |        | pF    |         |
| Channel-On Capacitance  | $C_{D(ON)} + C_{S(ON)}$ | $V_{IN} = 0V$ (DG308A), $V_{IN} = 15V$ (DG309), $V_D = V_S = 0V$                                   |                     | 27   |        |          | 27   |        | pF    |         |

**Note 1:** All leads are soldered or welded to the PC board.

**Note 2:** The algebraic convention where the most negative value is a minimum and the most positive value a maximum is used in this data sheet.

**Note 3:** Off isolation =  $20\log_{10} V_D/V_S$ ,  $V_D$  = output,  $V_S$  = input to off switch.

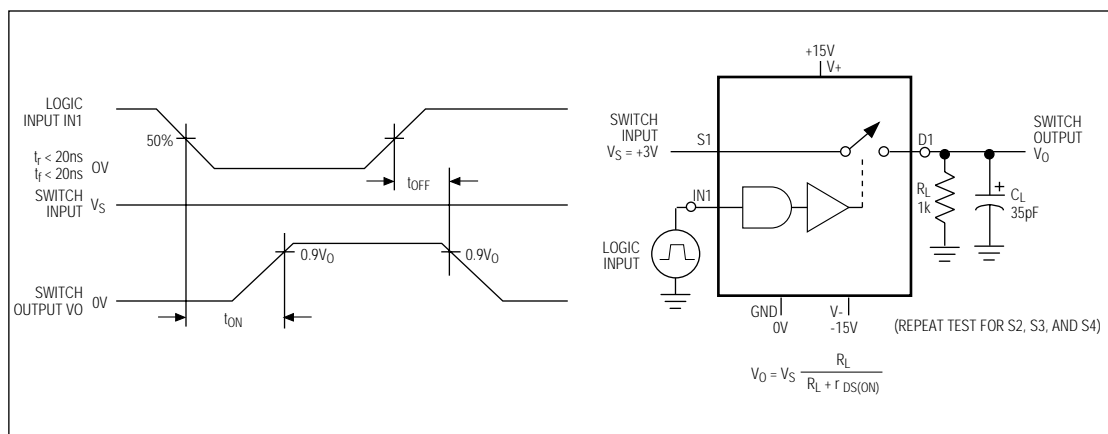
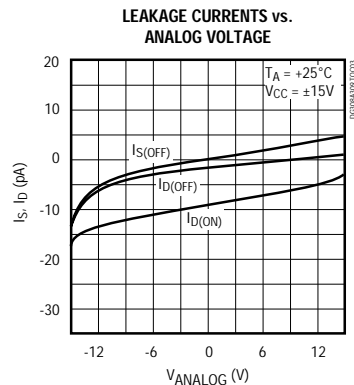
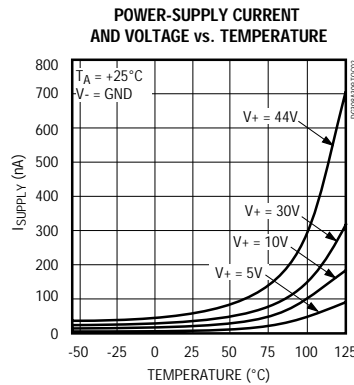
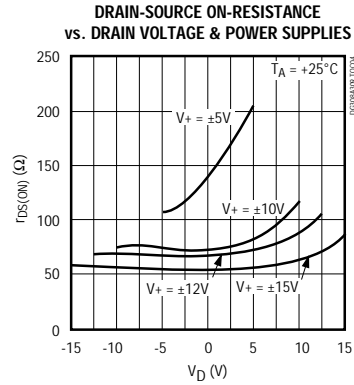
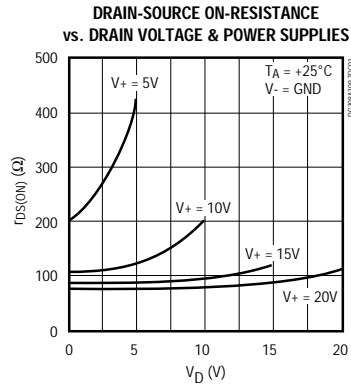


Figure 1. Switching-Time Test Circuit

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## Typical Operating Characteristics

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)



### Pin Description

| PIN          | NAME    | FUNCTION   |
|--------------|---------|--|
| 1, 8, 9, 16  | IN1-IN4 | Logic Control Inputs                                   |
| 2, 7, 10, 15 | D1-D4   | Drain Output   |
| 3, 6, 11, 14 | S1-S4   | Source Input   |
| 4            | V-      | Negative Supply Voltage Input                          |
| 5            | GND     | Ground   |
| 12           | N.C.    | No Connect. Not internally connected.                  |
| 13           | V+      | Positive Supply Voltage Input. Connected to substrate. |

### Applications Information

The DG308A/DG309 switch positive analog signals while using a single positive supply, allowing use in applications where only one supply is available. The disadvantages of using a single supply are slower switching speed and increased  $r_{DS(ON)}$ . The *Power-Supply Current and Voltage vs. Temperature* graph shows the typical curve for a single-supply design. As stated in the Absolute Maximum Ratings, the analog voltage should not go above or below the supply voltages, which are  $V+$  and  $0\text{V}$  in single-supply operation.

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