

# MAXIM

## Dual Monolithic SPST CMOS Analog Switch

DG200A

### General Description

The DG200A is a dual, normally closed, single-pole-single-throw (SPST) analog switch. This CMOS switch can be operated with power supplies ranging from  $\pm 4.5\text{V}$  to  $\pm 18\text{V}$ . The DG200A has guaranteed break-before-make switching. Its maximum turn-off time is 500ns, and its maximum turn-on time is 100ns.

Maxim guarantees that the DG200A will not latch-up if the power supplies are turned off with input signals still connected as long as absolute maximum ratings are not violated.

Compared to the original manufacturer's product, Maxim's DG200A consumes significantly lower power, making it better suited for portable applications.

### Applications

Winchester Disk Drives  
Test Equipment  
Communications Systems  
PBX, PABX  
Guidance and Control Systems  
Head up Displays  
Military Radios

### Features

- ◆ Improved 2nd Source Power Supply Current  $< 300\mu\text{A}$
- ◆ Wide Supply Range  $\pm 4.5\text{V}$  to  $\pm 18\text{V}$
- ◆ Single Supply Operation
- ◆ Non-Latching with Supplies Turned-off and Input Signals Present
- ◆ CMOS and TTL Logic Compatible
- ◆ Monolithic, Low Power CMOS Design

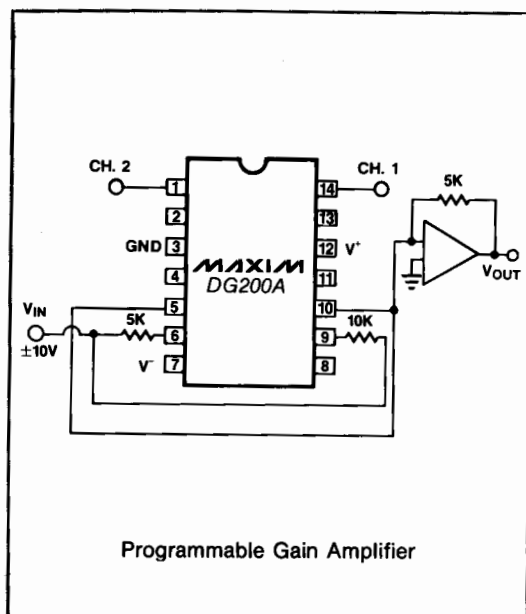
### Ordering Information

| PART      | TEMP. RANGE                                 | PIN-PACKAGE         |
|-----------|---|---------------------|
| DG200AAK  | $-55^\circ\text{C}$ to $+125^\circ\text{C}$ | 14 Lead Cerdip      |
| DG200ABK  | $-25^\circ\text{C}$ to $+85^\circ\text{C}$  | 14 Lead Cerdip*     |
| DG200ACK  | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 14 Lead Cerdip      |
| DG200ACJ  | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 14 Lead Plastic DIP |
| DG200ADJ  | $-40^\circ\text{C}$ to $+85^\circ\text{C}$  | 14 Lead Plastic DIP |
| DG200ACY  | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 14 Lead SO          |
| DG200ADY  | $-40^\circ\text{C}$ to $+85^\circ\text{C}$  | 14 Lead SO          |
| DG200AC/D | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | Dice                |
| DG200AAA  | $-55^\circ\text{C}$ to $+125^\circ\text{C}$ | 10 Pin Metal Can*   |
| DG200ABA  | $-25^\circ\text{C}$ to $+85^\circ\text{C}$  | 10 Pin Metal Can*   |
| DG200ACA  | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 10 Pin Metal Can*   |

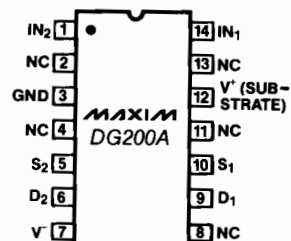
\*Contact factory for availability.

### Pin Configuration

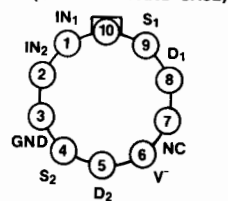
### Typical Operating Circuit



### Top View



### V+ (SUBSTRATE AND CASE)



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# Dual Monolithic SPST CMOS Analog Switch

## ABSOLUTE MAXIMUM RATINGS

|   |   |
|---|---|
| Voltages Referenced to $V^-$                |   |
| $V^+$ .....                                 | 44V   |
| GND .....                                   | 25V   |
| Digital Inputs $V_S$ , $V_D$ (Note 1) ..... | -2V to ( $V^+ + 2V$ )<br>or 20mA, whichever occurs first. |
| Current, Any Terminal Except S or D .....   | 30mA  |
| Continuous Current, S or D .....            | 20mA  |
| (Pulsed at 1msec, 10% duty cycle max) ..... | 100mA   |
| 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) .....                       | -25 to 85°C  |
| (D Suffix) .....                       | -40 to 85°C  |

|                              |       |
|------------------------------|-------|
| Power Dissipation (Package)* |       |
| Metal Can** .....            | 450mW |
| 14 Pin Ceramic DIP*** .....  | 825mW |
| 14 Pin Plastic DIP**** ..... | 470mW |

\* All leads soldered or welded to PC board.

\*\* Derate 6mW/°C above 75°C.

\*\*\* Derate 11mW/°C above 75°C.

\*\*\*\* Derate 6.5mW/°C above 25°C.

Stresses listed under "Absolute Maximum Ratings" may be applied (one at a time) to devices without resulting in permanent damage. These are stress ratings only, and functional operation of the device at these or any other conditions above 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 ( $V^+ = +15V$ , $V^- = -15V$ , GND = 0V, $T_A = 25^\circ C$ , unless otherwise indicated.)

| PARAMETER                                  | SYMBOL                                     | TEST CONDITIONS   | LIMITS                                      |                 |         |                 |                 |         | UNITS |
|--|--|---|---|-----------------|---------|-----------------|-----------------|---------|-------|
|  |  |   | DG200A                                      |                 |         | DG200 B/C/D     |                 |         |       |
|  |  |   | MIN<br>(Note 2)                             | TYP<br>(Note 3) | MAX     | MIN<br>(Note 2) | TYP<br>(Note 3) | MAX     |       |
| <b>SWITCH</b>                              |  |   |   |                 |         |                 |                 |         |       |
| Analog Signal Range<br>(Note 1)            | V <sub>ANALOG</sub>                        |   |   | -15             | 15      |                 | -15             | 15      | V     |
| Drain-Source<br>ON Resistance              | r <sub>DS(on)</sub>                        | V <sub>D</sub> = ±10V, V <sub>in</sub> = 0.8V,<br>I <sub>S</sub> = 1mA              |   | 45              | 70      |                 | 45              | 80      | Ω     |
| Source OFF<br>Leakage Current              | I <sub>S(off)</sub>                        | V <sub>in</sub> = 2.4V  | V <sub>S</sub> = 14V, V <sub>D</sub> = -14V | 0.01            | 2.0     |                 | 0.01            | 5.0     | nA    |
|  |  |   | V <sub>S</sub> = -14V, V <sub>D</sub> = 14V | -2.0            | -0.02   |                 | -5.0            | -0.02   |       |
| Drain OFF<br>Leakage Current               | I <sub>D(off)</sub>                        |   | V <sub>S</sub> = -14V, V <sub>D</sub> = 14V | 0.01            | 2.0     |                 | 0.01            | 5.0     |       |
|  |  |   | V <sub>S</sub> = 14V, V <sub>D</sub> = -14V | -2.0            | -0.02   |                 | -5.0            | -0.02   |       |
| Drain ON Leakage<br>Current (Note 4)       | I <sub>D(on)</sub>                         | V <sub>in</sub> = 0.8V  | V <sub>S</sub> = V <sub>D</sub> = 14V       | 0.1             | 2.0     |                 | 0.1             | 5.0     |       |
|  |  |   | V <sub>S</sub> = V <sub>D</sub> = -14V      | -2.0            | -0.1    |                 | -5.0            | -0.1    |       |
| <b>INPUT</b>                               |  |   |   |                 |         |                 |                 |         |       |
| Input Current with Input<br>Voltage High   | I <sub>INH</sub>                           | V <sub>in</sub> = 2.4V,<br>V <sub>in</sub> = 15V                                    |   | -1.0            | 0.0009  |                 | -1.0            | 0.0009  | μA    |
|  |  |   |   | 0.005           | 1.0     |                 | 0.005           | 1.0     |       |
| Input Current with Input<br>Voltage Low    | I <sub>INL</sub>                           | V <sub>in</sub> = 0V  |   | -1.0            | -0.0015 |                 | -1.0            | -0.0015 |       |
| <b>DYNAMIC</b>                             |  |   |   |                 |         |                 |                 |         |       |
| Turn-ON Time                               | t <sub>on</sub>                            | See Switching Time Test Circuit<br>(Figure 1)                                       |   | 440             | 1000    |                 | 440             | 1000    | ns    |
| Turn-OFF Time                              | t <sub>off</sub>                           |   |   | 70              | 500     |                 | 70              | 500     |       |
| Charge Injection                           | Q  | C <sub>L</sub> = 1000pF, V <sub>GEN</sub> = 0V,<br>R <sub>GEN</sub> = 0Ω (Figure 2) |   | 10              |         |                 | 10              |         | pC    |
| Source OFF Capacitance                     | C <sub>S(off)</sub>                        | f = 140kHz<br>V <sub>in</sub> = 5V<br>or<br>V <sub>S</sub> = 0V                     | V <sub>S</sub> = 0V                         | 9.0             |         |                 | 9.0             |         | pF    |
| Drain OFF Capacitance                      | C <sub>D(off)</sub>                        |   | V <sub>D</sub> = 0V                         | 9.0             |         |                 | 9.0             |         |       |
| Channel ON Capacitance                     | C <sub>D(on)</sub> +<br>C <sub>S(on)</sub> |   | V <sub>D</sub> = V <sub>S</sub> = 0V        | 25              |         |                 | 25              |         |       |
| OFF Isolation Figure 3<br>(Note 5)         |  | V <sub>in</sub> = 5V, Z <sub>L</sub> = 75Ω<br>V <sub>S</sub> = 2.0V, f = 1MHz       |   | 75              |         |                 | 75              |         | dB    |
| Crosstalk Figure 4<br>(Channel to Channel) |  |   |   | 90              |         |                 | 90              |         |       |

# Dual Monolithic SPST CMOS Analog Switch

DG200A

## ELECTRICAL CHARACTERISTICS (continued)

( $V^+ = +15V$ ,  $V^- = -15V$ , GND = 0V,  $T_A = 25^\circ C$ , unless otherwise indicated.)

| PARAMETER               | SYMBOL | TEST CONDITIONS   | LIMITS          |                 |     |                 |                 |     | UNITS |
|-------------------------|--------|---|-----------------|-----------------|-----|-----------------|-----------------|-----|-------|
|                         |        |   | DG200A          |                 |     | DG200 B/C/D     |                 |     |       |
|                         |        |   | MIN<br>(Note 2) | TYP<br>(Note 3) | MAX | MIN<br>(Note 2) | TYP<br>(Note 3) | MAX |       |
| SUPPLY                  |        |   |                 |                 |     |                 |                 |     |       |
| Positive Supply Current | I+     | Both Channels ON or OFF<br>V <sub>in</sub> = 0 and 2.4V | 180             | 300             |     | 200             | 500             | μA  |       |
| Negative Supply Current | I-     |   | -10             | -0.1            |     | -100            | -0.1            |     |       |

## ELECTRICAL CHARACTERISTICS (Over Temperature)

( $V^+ = +15V$ ,  $V^- = -15V$ , GND = 0V,  $T_A$  = Over Temperature Range, unless otherwise indicated.)

| PARAMETER                            | SYMBOL              | TEST CONDITIONS  | LIMITS                                      |      |     |                   |     |     | UNITS |    |
|--------------------------------------|---------------------|--|---|------|-----|-------------------|-----|-----|-------|----|
|                                      |                     |  | DG200A                                      |      |     | DG200 B/C         |     |     |       |    |
|                                      |                     |  | MIN   | TYP  | MAX | MIN               | TYP | MAX |       |    |
|                                      |                     |  | (Note 2) (Note 3)                           |      |     | (Note 2) (Note 3) |     |     |       |    |
| SWITCH                               |                     |  |   |      |     |                   |     |     |       |    |
| Analog Signal Range<br>(Note 1)      | V <sub>ANALOG</sub> |  |   | -15  |     | 15                | -15 |     | 15    | V  |
| Drain-Source<br>ON Resistance        | r <sub>DS(on)</sub> | V <sub>D</sub> = ±10V, V <sub>in</sub> = 0.8V,<br>I <sub>S</sub> = 1mA |   |      |     | 100               |     |     | 100   | Ω  |
| Source OFF<br>Leakage Current        | I <sub>S(off)</sub> | V <sub>in</sub> = 2.4V   | V <sub>S</sub> = 14V, V <sub>D</sub> = -14V |      |     | 100               |     |     | 100   | nA |
|                                      |                     |  | V <sub>S</sub> = -14V, V <sub>D</sub> = 14V | -100 |     | -100              |     |     |       |    |
| Drain OFF<br>Leakage Current         | I <sub>D(off)</sub> |  | V <sub>S</sub> = -14V, V <sub>D</sub> = 14V | 100  |     | 100               |     |     |       |    |
|                                      |                     |  | V <sub>S</sub> = 14V, V <sub>D</sub> = -14V | -100 |     | -100              |     |     |       |    |
| Drain ON Leakage<br>Current (Note 4) | I <sub>D(on)</sub>  | V <sub>in</sub> = 0.8V   | V <sub>S</sub> = V <sub>D</sub> = 14V       | 200  |     | 200               |     |     |       |    |
|                                      |                     |  | V <sub>S</sub> = V <sub>D</sub> = -14V      | -200 |     | -200              |     |     |       |    |
| INPUT                                |                     |  |   |      |     |                   |     |     |       |    |
| Input Current/<br>Voltage High       | I <sub>NH</sub>     | V <sub>in</sub> = 2.4V, V <sub>in</sub> = 15V                          |   | -10  |     | -10               |     | μA  |       |    |
|                                      |                     |  |   | 10   |     | 10                |     |     |       |    |
| Input Current/<br>Voltage Low        | I <sub>INL</sub>    | V <sub>in</sub> = 0V   |   | -10  |     | -10               |     |     |       |    |

**Note 1:** 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.

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

**Note 3:** Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

**Note 4:**  $I_{D(on)}$  is leakage from driver into "ON" switch.

**Note 5:** "OFF" isolation =  $20 \log V_S/V_D$ ,  $V_S$  = input to OFF switch,  $V_D$  = output.

# Dual Monolithic SPST CMOS Analog Switch

## Test Circuits

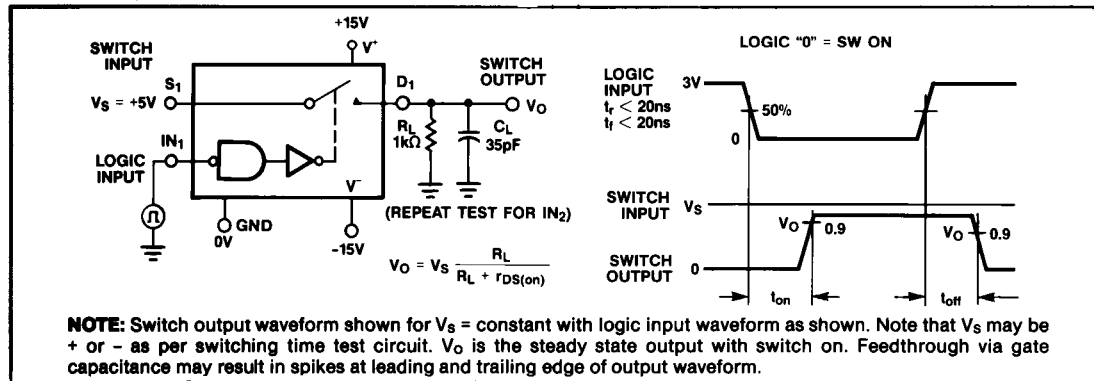


Figure 1. Switching Time Test Circuit

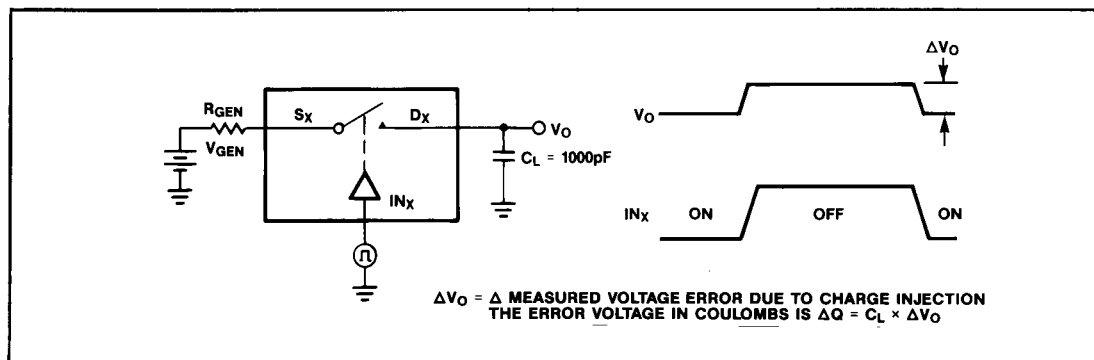


Figure 2. Charge Injection Test Circuit

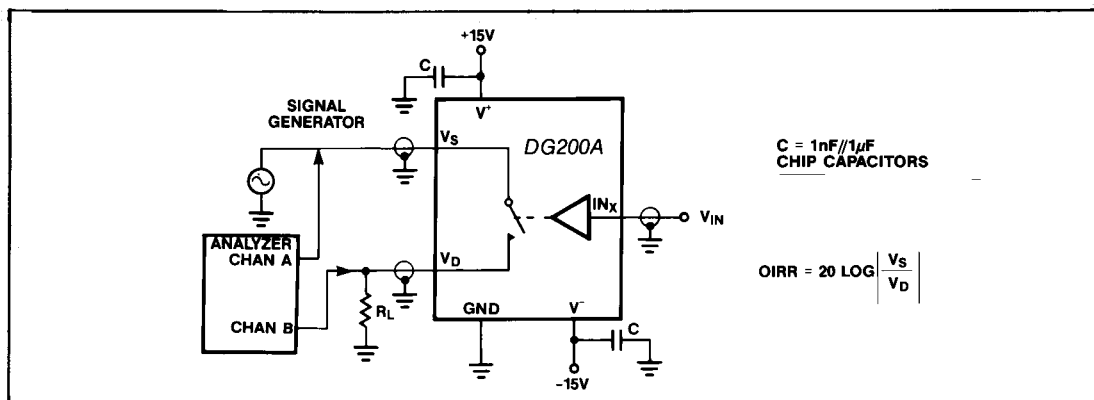


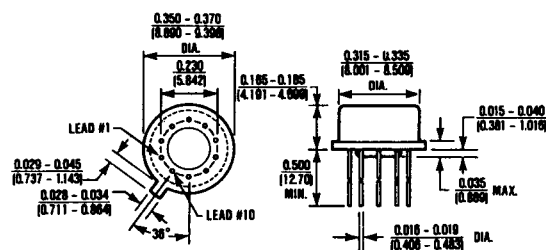
Figure 3. OFF Isolation Test Circuit

**DG200A**

The diagram shows a differential amplifier circuit for measuring CMRR. A signal generator is connected to the inputs of the amplifier. The amplifier has two inputs, IN<sub>1</sub> and IN<sub>2</sub>, and two outputs, V<sub>d</sub> and V<sub>d</sub>. A common-mode output V<sub>c</sub> is also shown. The circuit is powered by +15V and -15V. A resistor R<sub>L</sub> is connected to the common-mode output. A capacitor C is connected to the inputs. The CMRR is calculated as 20 LOG |V<sub>s1</sub>/V<sub>d2</sub>|.

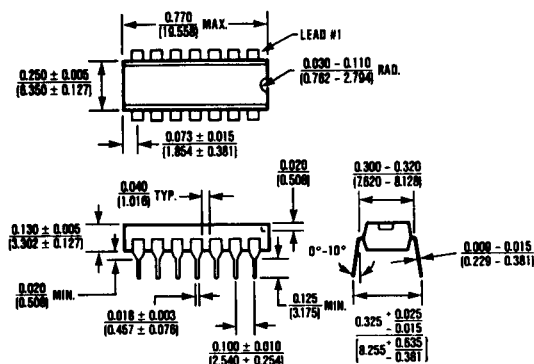
CMRR = 20 LOG  $\left| \frac{V_{S1}}{V_{D2}} \right|$

## Chip Topography

 $\theta_{JC} = 45^{\circ}\text{C/W}$

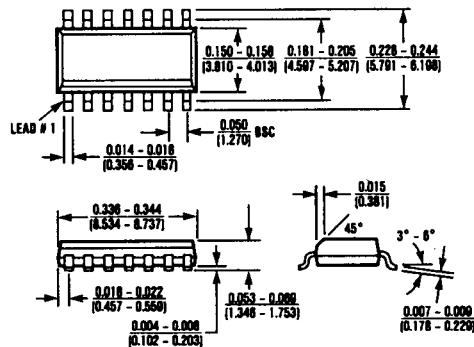
# Dual Monolithic SPST CMOS Analog Switch

## Package Information



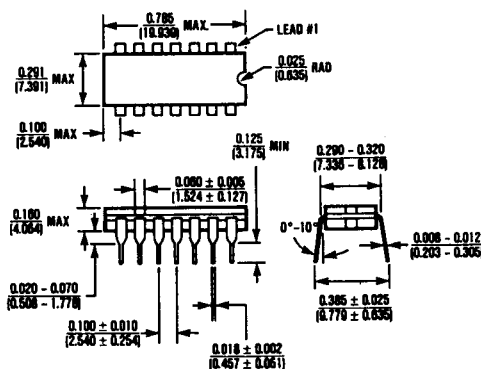
**14 Lead Plastic DIP (PD)**

$\theta_{JA} = 140^{\circ}\text{C/W}$   
 $\theta_{JC} = 70^{\circ}\text{C/W}$



**14 Lead Small Outline (SD)**

$\theta_{JA} = 115^{\circ}\text{C/W}$   
 $\theta_{JC} = 60^{\circ}\text{C/W}$



**14 Lead Cerdip (JD)**

$\theta_{JA} = 105^{\circ}\text{C/W}$   
 $\theta_{JC} = 50^{\circ}\text{C/W}$

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