

# MAXIM

## Quad SPST CMOS Analog Switches

### General Description

Maxim's MAX332, DG202 and DG212 are normally open, quad single-pole-single-throw (SPST) analog switches. These CMOS switches can be continuously operated with power supplies ranging from  $\pm 4.5\text{V}$  to  $\pm 18\text{V}$ . Maxim guarantees that the MAX332 and DG202/212 will not latch up if their power supplies are disconnected with input signals still connected.

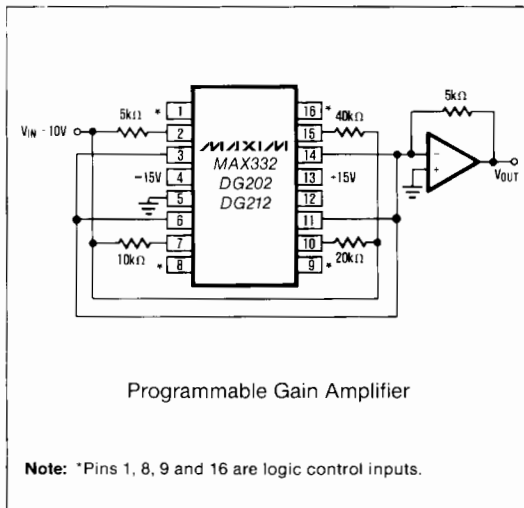
The MAX332 and DG202/DG212 are similar to the DG201 and DG211 except for inverted control inputs. All devices have guaranteed break-before-make switching as well as essentially constant on resistance over the analog signal range. All switches conduct current in either direction and add no offset to the output signal.

Compared to the original manufacturers products, Maxim's MAX332 and DG202/DG212 consume very little power, making them ideally suited for portable applications. Maxim has also eliminated the need for the third logic power supply ( $V_L$ ), required when operating the original manufacturer's DG212, without sacrificing compatibility.

### Applications

Analog Multiplexers  
Programmable Gain Amplifiers  
Communications Systems  
Sample/Holds  
Automatic Test Equipment  
PBX, PABX

### Typical Operating Circuit



### Features

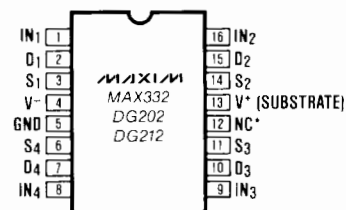
- ◆ Improved 2nd Source! (See pages 3 and 5 for "MAXIM Advantage™")
- ◆ Guaranteed  $\pm 4.5\text{V}$  to  $\pm 18\text{V}$  Operation
- ◆ No  $V_L$  Supply Required
- ◆ Non-Latching with Supplies Turned-off and Input Signals Present
- ◆ CMOS and TTL Logic Compatible
- ◆ Monolithic, Low Power CMOS Design

### Ordering Information

| PART      | TEMP. RANGE                                 | PACKAGE               |
|-----------|---------------------------------------------|-----------------------|
| MAX332MJE | $-55^\circ\text{C}$ to $+125^\circ\text{C}$ | 16 Lead Cerdip        |
| DG202C/D  | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | Dice                  |
| DG202CJ   | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 16 Lead Plastic DIP   |
| DG202CSE  | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 16 Lead Small Outline |
| DG202CK   | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 16 Lead Cerdip        |
| DG202BSE  | $-25^\circ\text{C}$ to $+85^\circ\text{C}$  | 16 Lead Small Outline |
| DG202BK   | $-25^\circ\text{C}$ to $+85^\circ\text{C}$  | 16 Lead Cerdip        |
| DG202AK   | $-55^\circ\text{C}$ to $+125^\circ\text{C}$ | 16 Lead Cerdip        |
| DG212C/D  | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | Dice                  |
| DG212CJ   | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 16 Lead Plastic DIP   |
| DG212CSE  | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 16 Lead Small Outline |

### Pin Configuration

Top View



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

Note: \*Pin 12 can be left open or connected to a logic supply voltage.

MAXIM

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Call toll free 1-800-998-8800 for free samples or literature.

MAX332/DG202/DG212

## Quad SPST CMOS Analog Switches

### ABSOLUTE MAXIMUM RATINGS (DG212)

|                                                                     |               |
|---------------------------------------------------------------------|---------------|
| $V^+$ to $V^-$ .....                                                | 40V           |
| $V_{IN}$ to Ground .....                                            | $V^-$ , $V^+$ |
| $V_L$ to Ground .....                                               | -0.3V, 25V    |
| $V_S$ or $V_D$ to $V^+$ .....                                       | 0, -40V       |
| $V_S$ or $V_D$ to $V^-$ .....                                       | 0, 40V        |
| $V^+$ to Ground .....                                               | 25V           |
| $V^-$ to Ground .....                                               | -25V          |
| Current, Any Terminal Except S or D .....                           | 30mA          |
| Continuous Current, S or D .....                                    | 20mA          |
| Peak Current, S or D<br>(Pulsed at 1msec, 10% duty cycle max) ..... | 70mA          |

|                                          |                 |
|------------------------------------------|-----------------|
| Storage Temperature .....                | -65°C to +125°C |
| Operating Temperature .....              | 0°C to +70°C    |
| Power Dissipation (Note 1)               |                 |
| 16 Pin Plastic DIP (Note 2) .....        | 470mW           |
| 16 Pin Small Outline (SE) (Note 3) ..... | 400mW           |

**Note 1:** Device mounted with all leads soldered to PC board.

**Note 2:** Derate 6.5mW/°C above +25°C.

**Note 3:** Derate 7mW/°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 ratings conditions for extended periods may affect device reliability.

### ELECTRICAL CHARACTERISTICS (DG212)

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

|         | PARAMETER                                | SYMBOL        | TEST CONDITIONS                                                                    | LIMITS          |                 |      | UNITS    |
|---------|------------------------------------------|---------------|------------------------------------------------------------------------------------|-----------------|-----------------|------|----------|
|         |                                          |               |                                                                                    | MIN<br>(Note 4) | TYP<br>(Note 5) | MAX  |          |
| SWITCH  | Analog Signal Range                      | $V_{ANALOG}$  |                                                                                    | -15             |                 | 15   | V        |
|         | Drain-Source ON Resistance               | $r_{DS(on)}$  | $V_D = \pm 10V$ , $V_{IN} = 2.4V$ , $I_S = 1mA$                                    |                 | 115             | 175  | $\Omega$ |
|         | Source OFF Leakage Current               | $I_{S(off)}$  | $V_{IN} = 0.8V$<br>$V_S = 14V$ , $V_D = -14V$<br>$V_S = -14V$ , $V_D = 14V$        |                 | 0.01<br>-5.0    | 5.0  | nA       |
|         | Drain OFF Leakage Current                | $I_{D(off)}$  | $V_{IN} = 0.8V$<br>$V_S = 14V$ , $V_D = -14V$<br>$V_S = -14V$ , $V_D = 14V$        |                 | 0.01<br>-5.0    | 5.0  |          |
|         | Drain ON Leakage Current<br>(Note 6)     | $I_{D(on)}$   | $V_S = V_D = 14V$ , $V_{IN} = 2.4V$<br>$V_S = V_D = -14V$ , $V_{IN} = 2.4V$        |                 | 0.1<br>-0.15    | 5.0  |          |
|         | Input Current With Input<br>Voltage High | $I_{INH}$     | $V_{IN} = 2.4V$<br>$V_{IN} = 15V$                                                  | -1.0            | -0.0004         |      | $\mu A$  |
| INPUT   | Input Current With Input<br>Voltage Low  | $I_{INL}$     | $V_{IN} = 0V$                                                                      | -1.0            | -0.0004         | 1.0  |          |
| DYNAMIC | Turn-ON Time                             | $t_{on}$      | See Switching Time<br>Test Circuit<br>$V_S = 2V$ , $R_L = 1k\Omega$ , $C_L = 35pF$ |                 | 460             | 1000 | ns       |
|         | Turn-OFF Time                            | $t_{off1}$    |                                                                                    |                 | 360             | 500  |          |
|         |                                          | $t_{off2}$    |                                                                                    |                 | 450             |      |          |
|         | Source OFF Capacitance                   | $C_{S(off)}$  | $V_S = 0V$ , $V_{IN} = 0V$ , $f = 1MHz$                                            |                 | 5               |      | pF       |
|         | Drain OFF Capacitance                    | $C_{D(off)}$  | $V_D = 0V$ , $V_{IN} = 0V$ , $f = 1MHz$                                            |                 | 5               |      |          |
|         | Channel ON Capacitance                   | $C_{D+S(on)}$ | $V_D = V_S = 5V$ , $V_{IN} = 0V$ , $f = 1MHz$                                      |                 | 16              |      |          |
|         | OFF Isolation (Note 7)                   | OIRR          | $V_{IN} = 0V$ , $R_L = 1k\Omega$ , $C_L = 15pF$ ,<br>$V_S = 1VRMS$ , $f = 100kHz$  |                 | 70              |      | dB       |
| SUPPLY  | Crosstalk<br>(Channel to Channel)        | CCRR          |                                                                                    |                 | 90              |      |          |
|         | Positive Supply Current                  | $I^+$         | $V_{IN} = 0V$ and $2.4V$                                                           |                 | 0.35            | 0.48 | mA       |
|         | Negative Supply Current                  | $I^-$         |                                                                                    |                 | 0.30            | 0.48 |          |
|         | Logic Supply Current                     | $I_L$         |                                                                                    |                 | 0.5             | 1.2  |          |

**Note 4:** 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 5:** Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

**Note 6:**  $I_{D(on)}$  is leakage from driver into "ON" switch.

**Note 7:** OFF Isolation =  $20 \log \frac{V_S}{V_D}$ ,  $V_S$  = input to OFF switch,  $V_D$  = output.

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## Quad SPST CMOS Analog Switches

- ◆ Significantly Reduced Power Consumption
- ◆ Third (Logic) Supply Not Required
- ◆ Fault Protected

**ABSOLUTE MAXIMUM RATINGS (DG212):** This device conforms to the Absolute Maximum Ratings on the adjacent page.

**ELECTRICAL CHARACTERISTICS (DG212):** Specifications below satisfy or exceed all “tested” parameters on adjacent page.

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

|         | PARAMETER                                      | SYMBOL        | TEST CONDITIONS                                                                    | LIMITS          |                  |              | UNITS    |
|---------|------------------------------------------------|---------------|------------------------------------------------------------------------------------|-----------------|------------------|--------------|----------|
|         |                                                |               |                                                                                    | MIN<br>(Note 4) | TYP<br>(Note 5)  | MAX          |          |
| SWITCH  | Analog Signal Range                            | $V_{ANALOG}$  |                                                                                    | -15             |                  | 15           | V        |
|         | Drain-Source ON Resistance                     | $r_{DS(on)}$  | $V_D = \pm 10V$ , $V_{IN} = 2.4V$ , $I_S = 1mA$                                    |                 | 115              | 175          | $\Omega$ |
|         | Source OFF Leakage Current                     | $I_{S(off)}$  | $V_{IN} = 0.8V$<br>$V_S = 14V$ , $V_D = -14V$<br>$V_S = -14V$ , $V_D = 14V$        |                 | 0.01<br>-5.0     | 5.0<br>-0.02 | nA       |
|         | Drain OFF Leakage Current                      | $I_{D(off)}$  | $V_{IN} = 0.8V$<br>$V_S = 14V$ , $V_D = -14V$<br>$V_S = -14V$ , $V_D = 14V$        |                 | 0.01<br>-5.0     | 5.0<br>-0.02 |          |
|         | Drain ON Leakage Current<br>(Note 6)           | $I_{D(on)}$   | $V_S = V_D = 14V$ , $V_{IN} = 2.4V$                                                |                 | 0.1              | 5.0          |          |
|         |                                                |               | $V_S = V_D = -14V$ , $V_{IN} = 2.4V$                                               |                 | -5.0             | -0.15        |          |
| INPUT   | Input Current With Input<br>Voltage High       | $I_{INH}$     | $V_{IN} = 2.4V$<br>$V_{IN} = 15V$                                                  | -1.0            | -0.0004<br>0.003 | 1.0          | $\mu A$  |
|         | Input Current With Input<br>Voltage Low        | $I_{INL}$     | $V_{IN} = 0V$                                                                      | -1.0            | -0.0004          |              |          |
| DYNAMIC | Turn-ON Time                                   | $t_{on}$      | See Switching Time<br>Test Circuit<br>$V_S = 2V$ , $R_L = 1k\Omega$ , $C_L = 35pF$ |                 | 460              | 1000         | ns       |
|         | Turn-OFF Time                                  | $t_{off1}$    |                                                                                    |                 | 360              | 500          |          |
|         |                                                | $t_{off2}$    |                                                                                    |                 | 450              |              |          |
|         | Source OFF Capacitance                         | $C_{S(off)}$  | $V_S = 0V$ , $V_{IN} = 0V$ , $f = 1MHz$                                            |                 | 5                |              | pF       |
|         | Drain OFF Capacitance                          | $C_{D(off)}$  | $V_D = 0V$ , $V_{IN} = 0V$ , $f = 1MHz$                                            |                 | 5                |              |          |
|         | Channel ON Capacitance                         | $C_{D+S(on)}$ | $V_D = V_S = 0V$ , $V_{IN} = 5V$ , $f = 1MHz$                                      |                 | 16               |              |          |
|         | OFF Isolation (Note 8)                         | OIRR          | $V_{IN} = 0V$ , $R_L = 1k\Omega$ , $C_L = 15pF$ ,<br>$V_S = 1VRMS$ , $f = 100kHz$  |                 | 70               |              | dB       |
|         | Crosstalk<br>(Channel to Channel)              | CCRR          |                                                                                    |                 | 90               |              |          |
| SUPPLY  | Positive Supply Current                        | $I^+$         | $V_{IN} = 0V$ and $2.4V$                                                           |                 | 0.02             | 0.1          | mA       |
|         | Negative Supply Current                        | $I^-$         |                                                                                    |                 | 0.00001          | 0.1          |          |
|         | Logic Supply Current                           | $I_L$         |                                                                                    |                 | 0.0              | 0.0          |          |
|         | Power Supply Range<br>for Continuous Operation | $V_{OP}$      |                                                                                    | $\pm 4.5$       |                  | $\pm 18$     | V        |

**Note 8:** Electrical characteristics, such as ON Resistance, will change when power supplies, other than  $\pm 15V$ , are used.

MAX332/DG202/DG212

## Quad SPST CMOS Analog Switches

### ABSOLUTE MAXIMUM RATINGS (DG202)

|                                                                      |                                                                 |
|----------------------------------------------------------------------|-----------------------------------------------------------------|
| Voltages Referenced to V <sup>-</sup>                                |                                                                 |
| V <sup>+</sup> .....                                                 | 44V                                                             |
| GND .....                                                            | 25V                                                             |
| Digital Inputs (Note 1), V <sub>S</sub> , V <sub>D</sub> .....       | -2V, to (V <sup>+</sup> +2V)<br>or 20mA, whichever occurs first |
| Current, Any Terminal Except S or D .....                            | 30mA                                                            |
| Continuous Current, S or D .....                                     | 20mA                                                            |
| Peak Current, S or D<br>(Pulsed at 1msec, 10% duty cycle max.) ..... | 70mA                                                            |
| Operating Temperature                                                |                                                                 |
| DG202 (A Suffix) .....                                               | -55°C to +125°C                                                 |
| (B Suffix) .....                                                     | -25°C to +85°C                                                  |
| (C Suffix) .....                                                     | 0°C to +70°C                                                    |
| MAX332MJE .....                                                      | -55°C to +125°C                                                 |

|                                          |                 |
|------------------------------------------|-----------------|
| Storage Temperature .....                | -65°C to +150°C |
| Power Dissipation (Note 2) .....         |                 |
| 16 Pin CERDIP (Note 3) .....             | 900mW           |
| 16 Pin Plastic DIP (Note 4) .....        | 470mW           |
| 16 Pin Small Outline (SE) (Note 5) ..... | 400mW           |

**Note 1:** Signals on S<sub>X</sub>, D<sub>X</sub>, or I<sub>NX</sub> exceeding V<sup>+</sup> or V<sup>-</sup> on Maxim's MAX332 and DG202 will be clamped by internal diodes, and are also internally current limited to 25mA.

**Note 2:** Device mounted with all leads soldered to PC board.

**Note 3:** Derate 12mW/°C above +75°C.

**Note 4:** Derate 6.5mW/°C above +25°C.

**Note 5:** Derate 7mW/°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 ratings conditions for extended periods may affect device reliability.

### ELECTRICAL CHARACTERISTICS (DG202)

(V<sup>+</sup> = +15V, V<sup>-</sup> = -15V, GND = 0V, T<sub>A</sub> = +25°C, unless otherwise noted)

|         | PARAMETER                             | SYMBOL                                    | TEST CONDITIONS                                                                               |                                                                                            | LIMITS                                                     |                 |                 |                 |                 |                 | UNITS |
|---------|---------------------------------------|-------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------|
|         |                                       |                                           |                                                                                               |                                                                                            | DG202A                                                     |                 |                 | DG202B,C        |                 |                 |       |
|         |                                       |                                           |                                                                                               |                                                                                            | MIN<br>(Note 6)                                            | TYP<br>(Note 7) | MAX<br>(Note 7) | MIN<br>(Note 6) | TYP<br>(Note 7) | MAX<br>(Note 7) |       |
| SWITCH  | Analog Signal Range                   | V <sub>ANALOG</sub>                       |                                                                                               |                                                                                            | -15                                                        |                 | 15              | -15             |                 | 15              | V     |
|         | Drain-Source ON Resistance            | r <sub>DS (on)</sub>                      | V <sub>D</sub> = ±10V, V <sub>IN</sub> = 2.4V, I <sub>S</sub> = 1mA                           |                                                                                            |                                                            | 115             | 175             |                 | 115             | 200             | Ω     |
|         | Source OFF Leakage Current            | I <sub>S (off)</sub>                      | V <sub>IN</sub> = 0.8V                                                                        | V <sub>S</sub> = 14V, V <sub>D</sub> = -14V<br>V <sub>S</sub> = -14V, V <sub>D</sub> = 14V | 0.01<br>-5.0                                               | 1.0<br>-0.02    |                 | 0.01<br>-5.0    | 5.0<br>-0.02    |                 | nA    |
|         | Drain OFF Leakage Current             | I <sub>D (off)</sub>                      | V <sub>IN</sub> = 0.8V                                                                        | V <sub>S</sub> = 14V, V <sub>D</sub> = -14V<br>V <sub>S</sub> = -14V, V <sub>D</sub> = 14V | 0.01<br>-5.0                                               | 1.0<br>-0.02    |                 | 0.01<br>-5.0    | 5.0<br>-0.02    |                 | nA    |
|         | Drain ON Leakage Current (Note 8)     | I <sub>D (on)</sub>                       | V <sub>S</sub> = -14V, V <sub>IN</sub> = 2.4V<br>V <sub>D</sub> = 14V, V <sub>IN</sub> = 2.4V |                                                                                            | 0.1<br>-1.0                                                | 1.0<br>-0.15    |                 | 0.1<br>-5.0     | 5.0<br>-0.15    |                 | nA    |
| INPUT   | Input Current With Input Voltage High | I <sub>INH</sub>                          | V <sub>IN</sub> = 2.4V<br>V <sub>IN</sub> = 15V                                               |                                                                                            | -1.0<br>0.003                                              | -0.0004<br>1.0  |                 | -1.0<br>0.003   | -0.0004<br>1.0  |                 | μA    |
|         | Input Current With Input Voltage Low  | I <sub>INL</sub>                          | V <sub>IN</sub> = 0V                                                                          |                                                                                            | -1.0                                                       | -0.0004         |                 | -1.0            | -0.0004         |                 | μA    |
| DYNAMIC | Turn-ON Time                          | t <sub>on</sub>                           | See Switching Time Test Circuit                                                               |                                                                                            | 480                                                        | 600             |                 | 480             | 600             |                 | ns    |
|         | Turn-OFF Time                         | t <sub>off</sub>                          |                                                                                               |                                                                                            | 370                                                        | 450             |                 | 370             | 450             |                 | ns    |
|         | Charge Injection                      | Q                                         | C <sub>L</sub> = 1000pF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω                         |                                                                                            | 20                                                         |                 |                 | 20              |                 |                 | pC    |
|         | Source OFF Capacitance                | C <sub>S (off)</sub>                      | V <sub>S</sub> = 0V, V <sub>IN</sub> = 0V                                                     |                                                                                            | 5                                                          |                 |                 | 5               |                 |                 | pF    |
|         | Drain OFF Capacitance                 | C <sub>D (off)</sub>                      | f = 140kHz                                                                                    |                                                                                            | 5                                                          |                 |                 | 5               |                 |                 | pF    |
|         | Channel ON Capacitance                | C <sub>D (on)</sub> + C <sub>S (on)</sub> |                                                                                               |                                                                                            | V <sub>D</sub> = V <sub>S</sub> = 0V, V <sub>IN</sub> = 5V |                 | 16              |                 |                 | 16              |       |
|         | OFF Isolation                         |                                           | V <sub>IN</sub> = 0V, Z <sub>L</sub> = 75kΩ                                                   |                                                                                            | 70                                                         |                 |                 | 70              |                 |                 | dB    |
|         | Crosstalk (Channel to Channel)        |                                           | V <sub>S</sub> = 2.0V, f = 100kHz                                                             |                                                                                            | 90                                                         |                 |                 | 90              |                 |                 | dB    |
| SUP-PLY | Positive Supply Current               | I <sup>+</sup>                            | All Channels ON or OFF                                                                        |                                                                                            | 0.9                                                        | 2               |                 | 0.9             | 2               |                 | mA    |
|         | Negative Supply Current               | I <sup>-</sup>                            | All Channels ON or OFF                                                                        |                                                                                            | -1                                                         | -0.3            |                 | -1              | -0.3            |                 | mA    |

**Note 6:** 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 7:** Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

**Note 8:** I<sub>D(on)</sub> is leakage from driver into "ON" switch.

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## Quad SPST CMOS Analog Switches

- ◆ Significantly Reduced Power Consumption
- ◆ Lower Input Current Over Temperature
- ◆ No Input Current Spike

**ABSOLUTE MAXIMUM RATINGS (MAX332, DG202):** This device conforms to the Absolute Maximum Ratings on the adjacent page.

**ELECTRICAL CHARACTERISTICS (MAX332, DG202):** Specifications below satisfy or exceed all "tested" parameters on adjacent page.

(V<sup>+</sup> = +15V, V<sup>-</sup> = -15V, GND = 0V, T<sub>A</sub> = +25°C, unless otherwise noted)

|                                | PARAMETER                                   | SYMBOL                                    | TEST CONDITIONS                                                                               |                                                                                            | LIMITS                                                     |                 |     |                 |                 |     | UNITS |
|--------------------------------|---------------------------------------------|-------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------------|-----|-----------------|-----------------|-----|-------|
|                                |                                             |                                           |                                                                                               |                                                                                            | MAX332/DG202A                                              |                 |     | DG202B,C        |                 |     |       |
|                                |                                             |                                           |                                                                                               |                                                                                            | MIN<br>(Note 6)                                            | TYP<br>(Note 7) | MAX | MIN<br>(Note 6) | TYP<br>(Note 7) | MAX |       |
| SWITCH                         | Analog Signal Range                         | V <sub>ANALOG</sub>                       |                                                                                               |                                                                                            | -15                                                        |                 | 15  | -15             |                 | 15  | V     |
|                                | Drain-Source ON Resistance (Note 9)         | r <sub>DS (on)</sub>                      | V <sub>D</sub> = ±10V, V <sub>IN</sub> = 2.4V, I <sub>S</sub> = 1mA                           |                                                                                            |                                                            | 115             | 175 |                 | 115             | 200 | Ω     |
|                                | Source OFF Leakage Current                  | I <sub>S (off)</sub>                      | V <sub>IN</sub> = 0.8V                                                                        | V <sub>S</sub> = 14V, V <sub>D</sub> = -14V<br>V <sub>S</sub> = -14V, V <sub>D</sub> = 14V |                                                            | 0.01            | 1.0 |                 | 0.01            | 5.0 | nA    |
|                                | Drain OFF Leakage Current                   | I <sub>D (off)</sub>                      | V <sub>IN</sub> = 0.8V                                                                        | V <sub>S</sub> = 14V, V <sub>D</sub> = -14V<br>V <sub>S</sub> = -14V, V <sub>D</sub> = 14V |                                                            | 0.01            | 1.0 |                 | 0.01            | 5.0 |       |
|                                | Drain ON Leakage Current (Note 8)           | I <sub>D (on)</sub>                       | V <sub>S</sub> = -14V, V <sub>IN</sub> = 2.4V<br>V <sub>D</sub> = 14V, V <sub>IN</sub> = 2.4V |                                                                                            | 0.1                                                        | 1.0             |     | 0.1             | 5.0             |     |       |
| INPUT                          | Input Current With Input Voltage High       | I <sub>INH</sub>                          | V <sub>IN</sub> = 2.4V<br>V <sub>IN</sub> = 15V                                               |                                                                                            | -1.0                                                       | -0.0004         |     | -1.0            | -0.0004         |     | μA    |
|                                | Input Current With Input Voltage Low        | I <sub>INL</sub>                          | V <sub>IN</sub> = 0V                                                                          |                                                                                            | -1.0                                                       | -0.0004         |     | -1.0            | -0.0004         |     |       |
|                                | DYNAMIC                                     | Turn-ON Time                              | t <sub>on</sub>                                                                               | See Switching Time Test Circuit                                                            |                                                            | 480             | 600 |                 | 480             | 600 | ns    |
| Turn-OFF Time                  |                                             | t <sub>off1</sub>                         | 370                                                                                           |                                                                                            |                                                            | 450             |     | 370             | 450             |     |       |
| Charge Injection               |                                             | Q                                         | C <sub>L</sub> = 1000pF, V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0Ω                         |                                                                                            | 20                                                         |                 |     | 20              | pC              |     |       |
| Source OFF Capacitance         |                                             | C <sub>S (off)</sub>                      | V <sub>S</sub> = 0V, V <sub>IN</sub> = 0V<br>f = 140kHz                                       |                                                                                            | 5                                                          |                 |     | 5               | pF              |     |       |
| Drain OFF Capacitance          |                                             | C <sub>D (off)</sub>                      |                                                                                               |                                                                                            | 5                                                          |                 |     | 5               |                 |     |       |
| Channel ON Capacitance         |                                             | C <sub>D (on)</sub> + C <sub>S (on)</sub> |                                                                                               |                                                                                            | V <sub>D</sub> = V <sub>S</sub> = 0V, V <sub>IN</sub> = 5V | 16              |     |                 |                 | 16  |       |
| OFF Isolation                  |                                             |                                           | V <sub>IN</sub> = 0V, Z <sub>L</sub> = 75kΩ                                                   |                                                                                            | 70                                                         |                 |     | 70              | dB              |     |       |
| Crosstalk (Channel to Channel) |                                             | V <sub>S</sub> = 2.0V, f = 100kHz         |                                                                                               | 90                                                                                         |                                                            |                 | 90  |                 |                 |     |       |
| SUPPLY                         | Positive Supply Current                     | I <sup>+</sup>                            | All Channels ON or OFF                                                                        |                                                                                            | 0.02                                                       | 0.1             |     | 0.02            | 0.1             | mA  |       |
|                                | Negative Supply Current                     | I <sup>-</sup>                            | All Channels ON or OFF                                                                        |                                                                                            | -0.1                                                       | -0.01           |     | -0.1            | -0.01           |     |       |
|                                | Power Supply Range for Continuous Operation | V <sub>OP</sub>                           |                                                                                               |                                                                                            | ±4.5                                                       |                 | ±18 | ±4.5            |                 | ±18 | V     |

**Note 6:** 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 7:** Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

**Note 8:** I<sub>D(on)</sub> is leakage from driver into "ON" switch.

**Note 9:** Electrical characteristics, such as ON Resistance, will change when power supplies other than ±15V, are used.

MAX332/DG202/DG212

## Quad SPST CMOS Analog Switches

### ELECTRICAL CHARACTERISTICS (DG202)

( $V^+ = +15V$ ,  $V^- = -15V$ , GND = 0V,  $T_A$  = Full Operating Temperature Range)

|                                    | PARAMETER                             | SYMBOL                                        | TEST CONDITIONS                                                     |                                             | LIMITS   |          |      |          |          |     | UNITS |
|------------------------------------|---------------------------------------|-----------------------------------------------|---------------------------------------------------------------------|---------------------------------------------|----------|----------|------|----------|----------|-----|-------|
|                                    |                                       |                                               |                                                                     |                                             | DG202A   |          |      | DG202B,C |          |     |       |
|                                    |                                       |                                               |                                                                     |                                             | MIN      | TYP      | MAX  | MIN      | TYP      | MAX |       |
|                                    |                                       |                                               |                                                                     |                                             | (Note 6) | (Note 7) |      | (Note 6) | (Note 7) |     |       |
| SWITCH                             | Analog Signal Range                   | V <sub>ANALOG</sub>                           |                                                                     |                                             | -15      |          | 15   | -15      |          | 15  | V     |
|                                    | Drain-Source ON Resistance            | r <sub>DS (on)</sub>                          | V <sub>D</sub> = ±10V, V <sub>IN</sub> = 2.4V, I <sub>S</sub> = 1mA |                                             |          |          | 250  |          |          | 250 | Ω     |
|                                    | Source OFF Leakage Current            | I <sub>S (off)</sub>                          | V <sub>IN</sub> = 0.8V                                              | 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 Leakage Current             | I <sub>D (off)</sub>                          | V <sub>IN</sub> = 0.8V                                              | 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 Current (Note 10) | I <sub>D (on)</sub>                   | V <sub>S</sub> = -14V, V <sub>IN</sub> = 2.4V |                                                                     |                                             |          | 200      |      |          | 200      |     |       |
|                                    |                                       |                                               | V <sub>D</sub> = 14V, V <sub>IN</sub> = 2.4V                        |                                             | -200     |          |      | -200     |          |     |       |
| INPUT                              | Input Current With Input Voltage High | I <sub>INH</sub>                              | V <sub>IN</sub> = 2.4V                                              |                                             | -1.0     |          |      | -10      |          |     | μA    |
|                                    |                                       |                                               | V <sub>IN</sub> = 15V                                               |                                             |          |          | -10  |          |          | -10 |       |
|                                    | Input Current With Input Voltage Low  | I <sub>INL</sub>                              | V <sub>IN</sub> = 0V                                                |                                             | -10      |          |      | -10      |          |     |       |

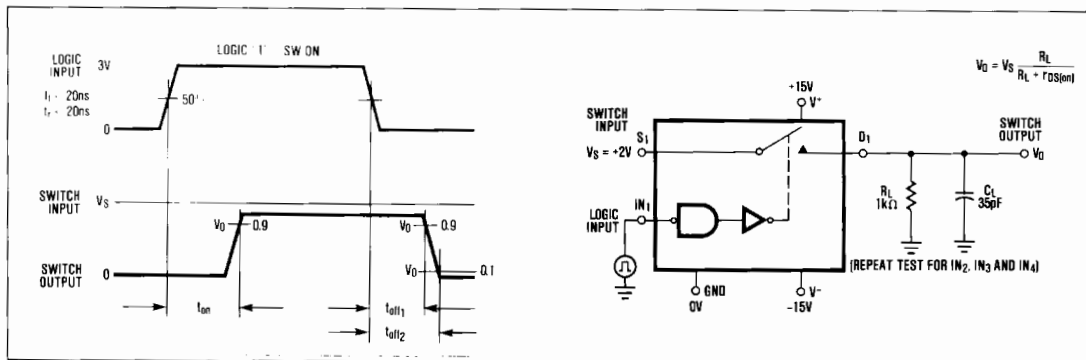
**Note 10:**  $I_{D(on)}$  is leakage from driver into "ON" switch.

The electrical characteristics above are a reproduction of a portion of Siliconix's copyrighted 1985 data book. This information does not constitute any representation by Maxim that Siliconix's products will perform in accordance with these specifications. The "Electrical Characteristics Table" along with descriptive excerpts from the original manufacturer's data sheet have been included in this data sheet solely for comparative purposes.

### Switching Time Test Circuit

Switch output waveform shown for  $V_S =$  constant with logic input waveform as shown. Note that  $V_S$  may be +ve or -ve as per switching times test circuit.

$V_O$  is the steady state output with switch on. Feed-through via gate capacitance may result in spikes at leading and trailing edge of output waveform.



### Typical $R_{DS(ON)}$ vs. Power Supplies for Maxim's MAX332, DG202/DG212

| POWER SUPPLIES | $R_{DS(ON)}$ AT ANALOG SIGNAL LEVEL |              |              |              |              |              |
|----------------|-------------------------------------|--------------|--------------|--------------|--------------|--------------|
|                | -5V                                 | +5V          | -10V         | +10V         | -15V         | +15V         |
| $\pm 5V$       | 350 $\Omega$                        | 380 $\Omega$ |              |              |              |              |
| $\pm 10V$      |                                     |              | 165 $\Omega$ | 250 $\Omega$ |              |              |
| $\pm 15V$      |                                     |              | 125 $\Omega$ | 160 $\Omega$ | 135 $\Omega$ | 155 $\Omega$ |



## Quad SPST CMOS Analog Switches

### ELECTRICAL CHARACTERISTICS (MAX332, DG202):

(V<sup>+</sup> = +15V, V<sup>-</sup> = -15V, GND = 0V, T<sub>A</sub> = full operating temperature range)

|                                    | PARAMETER                             | SYMBOL                                        | TEST CONDITIONS                                                     |                                             | LIMITS        |          |      |          |          |     | UNITS |
|------------------------------------|---------------------------------------|-----------------------------------------------|---------------------------------------------------------------------|---------------------------------------------|---------------|----------|------|----------|----------|-----|-------|
|                                    |                                       |                                               |                                                                     |                                             | MAX332/DG202A |          |      | DG202B,C |          |     |       |
|                                    |                                       |                                               |                                                                     |                                             | MIN           | TYP      | MAX  | MIN      | TYP      | MAX |       |
|                                    |                                       |                                               |                                                                     |                                             | (Note 6)      | (Note 7) |      | (Note 6) | (Note 7) |     |       |
| SWITCH                             | Analog Signal Range                   | V <sub>ANALOG</sub>                           |                                                                     |                                             | -15           |          | 15   | -15      |          | 15  | V     |
|                                    | Drain-Source ON Resistance (Note 11)  | r <sub>DS (on)</sub>                          | V <sub>D</sub> = ±10V, V <sub>IN</sub> = 2.4V, I <sub>S</sub> = 1mA |                                             |               |          | 250  |          |          | 250 | Ω     |
|                                    | Source OFF Leakage Current            | I <sub>S (off)</sub>                          | V <sub>IN</sub> = 0.8V                                              | 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 Leakage Current             | I <sub>D (off)</sub>                          | V <sub>IN</sub> = 0.8V                                              | 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 Current (Note 10) | I <sub>D (on)</sub>                   | V <sub>S</sub> = -14V, V <sub>IN</sub> = 2.4V |                                                                     |                                             |               | 200      |      |          | 200      |     |       |
|                                    |                                       | V <sub>D</sub> = 14V, V <sub>IN</sub> = 2.4V  |                                                                     | -200                                        |               |          | -200 |          |          |     |       |
| INPUT                              | Input Current With Input Voltage High | I <sub>INH</sub>                              | V <sub>IN</sub> = 2.4V                                              |                                             | -1.0          |          |      | -1.0     |          |     | μA    |
|                                    |                                       |                                               | V <sub>IN</sub> = 15V                                               |                                             |               |          | 1.0  |          |          | 1.0 |       |
|                                    | Input Current With Input Voltage Low  | I <sub>INL</sub>                              | V <sub>IN</sub> = 0V                                                |                                             | -1.0          |          |      | -1.0     |          |     |       |

Note 10: I<sub>D(on)</sub> is leakage from driver into "ON" switch.

Note 11: Electrical characteristics, such as ON Resistance, will change when power supplies other than ±15V, are used.

### Protecting Against Fault Conditions

Fault conditions occur when power supplies are turned off when input signals are still present or when over voltages occur at the inputs during normal operation. In either case, source-to-body diodes can be forward biased and conduct current from the signal source. If this current is required to be kept to low (μA) levels then the addition of external protection diodes is recommended.

To provide protection for over-voltages up to 20V above the supplies, a 1N4001 or 1N914 type diode should be placed in series with the positive and negative supplies as shown in Fig. 1. The addition of these diodes will reduce the analog signal range to 1 volt below the positive supply and 1 volt above the negative supply.

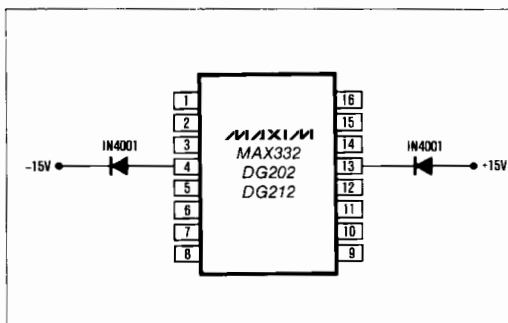
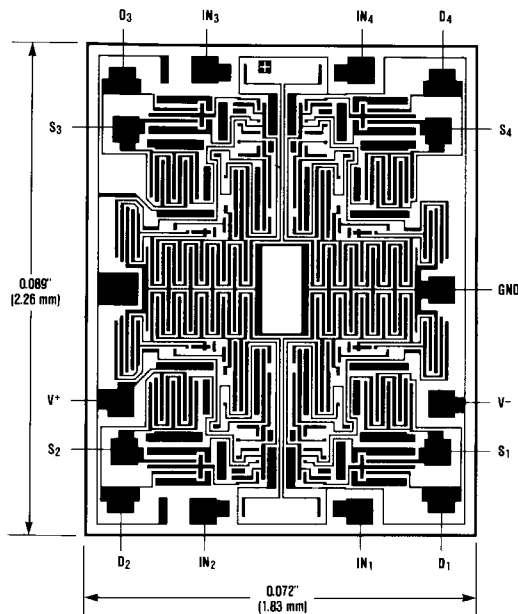


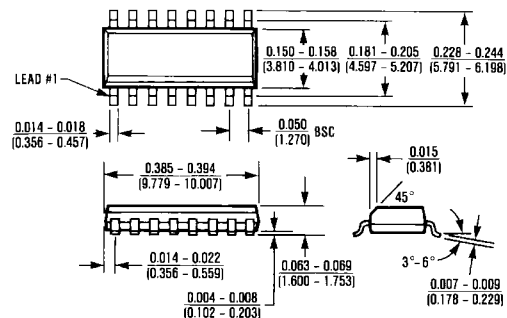
Figure 1. Protection Against Fault Conditions

# Quad SPST CMOS Analog Switches

## Chip Topography

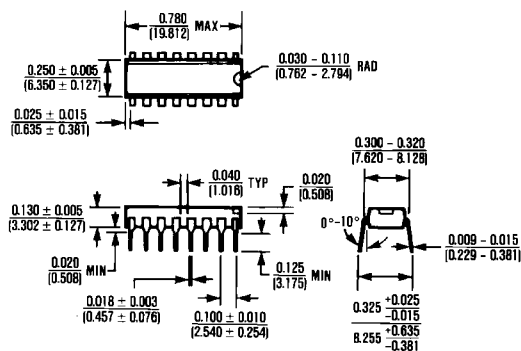


## Package Information



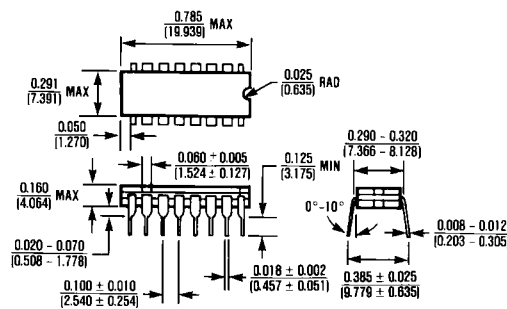
16 Lead Small Outline (SE)

$\theta_{JA} = 110^{\circ}\text{C/W}$   
 $\theta_{JC} = 60^{\circ}\text{C/W}$



16 Lead Plastic DIP

$\theta_{JA} = 135^{\circ}\text{C/W}$   
 $\theta_{JC} = 65^{\circ}\text{C/W}$



16 Lead CERPDP

$\theta_{JA} = 100^{\circ}\text{C/W}$   
 $\theta_{JC} = 60^{\circ}\text{C/W}$

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