



# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

## General Description

The MAX4800A/MAX4802A provide high-voltage switching on eight channels for ultrasonic imaging and printer applications. The devices utilize BCDMOS process technology to provide eight high-voltage low-charge-injection SPST switches, controlled by a 20MHz serial interface. Data is clocked into an internal 8-bit shift register and retained by a programmable latch with enable and clear inputs. A power-on reset function ensures that all switches are open on power-up.

The devices operate with a wide range of high-voltage supplies including:  $V_{PP}/V_{NN} = +100V/-100V$ ,  $+185V/-15V$ , and  $+40V/-160V$ . The digital interface operates from a separate  $V_{DD}$  supply from  $+2.7V$  to  $+6V$ . Digital inputs DIN, CLK, LE, and CLR are  $+6V$  tolerant, independent of the  $V_{DD}$  supply voltage. The MAX4802A provides integrated  $35k\Omega$  bleed resistors on each switch terminal to discharge capacitive loads.

The devices are drop-in replacements for the Supertex HV2203 and HV2303. They are available in the 48-pin LQFP, 26-bump CSBGA, and 28-pin PLCC packages. All devices are specified for the commercial  $0^{\circ}C$  to  $+70^{\circ}C$  temperature range.

## Applications

Ultrasound Imaging  
Printers

## Ordering Information/ Selector Guide

| PART          | BLEED RESISTORS | SECOND SOURCE | PIN-PACKAGE |
|---------------|-----------------|---------------|-------------|
| MAX4800ACXZ+* | No              | —             | 26 CSBGA    |
| MAX4800ACQI+  | No              | HV2203PJ-G    | 28 PLCC     |
| MAX4800ACCM+* | No              | HV2203FG-G    | 48 LQFP     |
| MAX4802ACXZ+* | Yes             | —             | 26 CSBGA    |
| MAX4802ACQI+  | Yes             | HV2303PJ-G    | 28 PLCC     |
| MAX4802ACCM+* | Yes             | HV2303FG-G    | 48 LQFP     |

**Note:** All devices are specified over the commercial  $0^{\circ}C$  to  $+70^{\circ}C$  temperature range.

\*Future product—contact factory for availability.

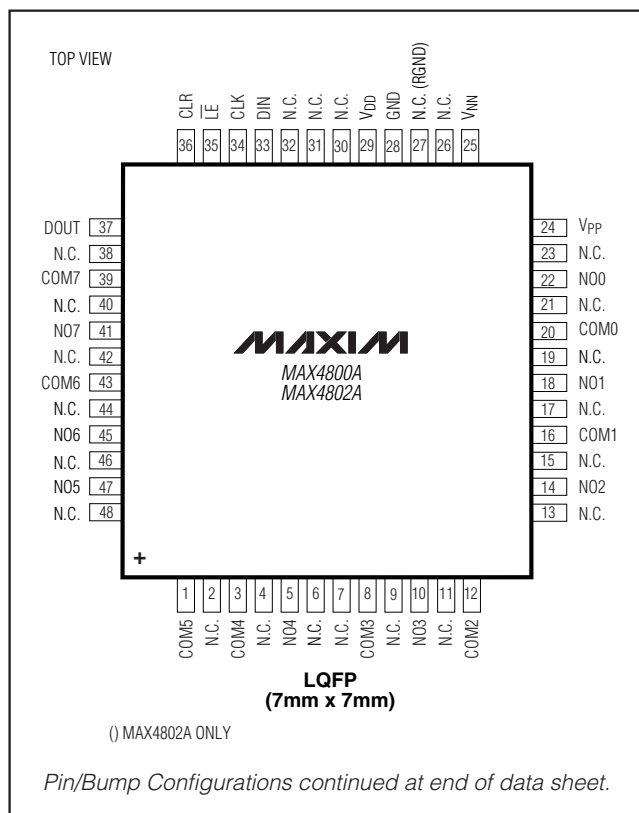
+Denotes a lead(Pb)-free/RoHS-compliant package.

SPI is a trademark of Motorola, Inc.

## Features

- ◆ Fast SPI™ Interface 20MHz
- ◆ Pin-Compatible Replacement for Supertex HV2203 (MAX4800A)
- ◆ Pin-Compatible Replacement for Supertex HV2303 (MAX4802A)
- ◆ Flexible High-Voltage Supplies Up to  $V_{PP} - V_{NN} = 200V$
- ◆ Low-Charge-Injection, Low-Capacitance  $22\Omega$  Switches
- ◆ DC to 50MHz Analog-Signal Frequency Range
- ◆  $-77dB$  Off-Isolation at 5MHz
- ◆ Low  $10\mu A$  Quiescent Current
- ◆ Integrated Bleed Resistors (MAX4802A Only)
- ◆ Available in Standard PLCC, LQFP, and CSBGA Packages

## Pin/Bump Configurations



For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at [www.maxim-ic.com](http://www.maxim-ic.com).

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## ABSOLUTE MAXIMUM RATINGS

(All voltages referenced to GND.)

|  |                                    |
|--|------------------------------------|
| V <sub>DD</sub> Logic Supply Voltage.....              | -0.3V to +7V                       |
| V <sub>PP</sub> - V <sub>NN</sub> Supply Voltage ..... | 220V                               |
| V <sub>PP</sub> Positive Supply Voltage.....           | -0.3V to (V <sub>NN</sub> + 220V)  |
| V <sub>NN</sub> Negative Supply Voltage .....          | +0.3V to -220V                     |
| Logic Inputs $\overline{LE}$ , CLR, CLK, DIN .....     | -0.3V to +7V                       |
| DOUT.....  | -0.3V to (V <sub>DD</sub> + 0.3V)  |
| RGND (MAX4802A).....                                   | -4.5V to +0.3V                     |
| COM <sub>-</sub> , NO <sub>-</sub> .....               | V <sub>NN</sub> to V <sub>PP</sub> |
| Continuous Power Dissipation (T <sub>A</sub> = +70°C)  |                                    |
| 26-Bump CSBGA (derate 11.8mW/°C above +70°C).....      | 941mW                              |
| 28-Pin PLCC (derate 10.5mW/°C above +70°C) .....       | 842mW                              |
| 48-Pin LQFP (derate 22.7mW/°C above +70°C).....        | 1818mW                             |

|   |                 |
|---|-----------------|
| Operating Temperature Range.....                      | 0°C to +70°C    |
| Storage Temperature Range .....                       | -65°C to +150°C |
| Junction Temperature .....                            | +150°C          |
| Lead Temperature (excluding CSBGA, soldering, 10s) .. | +300°C          |
| Soldering Temperature (reflow)                        |                 |
| 28 PLCC.....  | +245°C          |
| All other packages .....                              | +260°C          |

## PACKAGE THERMAL CHARACTERISTICS (Note 1)

|          |   |        |         |   |        |
|----------|---|--------|---------|---|--------|
| 26 CSBGA | Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ )..... | 85°C/W | 48 LQFP | Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ )..... | 44°C/W |
|          | Junction-to-Case Thermal Resistance ( $\theta_{JC}$ ).....    | 23°C/W |         | Junction-to-Case Thermal Resistance ( $\theta_{JC}$ ).....    | 10°C/W |
| 28 PLCC  | Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ )..... | 44°C/W |         |   |        |
|          | Junction-to-Case Thermal Resistance ( $\theta_{JC}$ ).....    | 10°C/W |         |   |        |

**Note 1:** Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to [www.maxim-ic.com/thermal-tutorial](http://www.maxim-ic.com/thermal-tutorial).

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>DD</sub> = +2.7V to +6V, V<sub>PP</sub> = +40V to (V<sub>NN</sub> + 200V), V<sub>NN</sub> = -40V to -160V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                            | SYMBOL                                  | CONDITIONS   |                             | MIN                     | TYP | MAX                     | UNITS    |
|--------------------------------------|---|--|-----------------------------|-------------------------|-----|-------------------------|----------|
| <b>ANALOG SWITCH</b>                 |   |  |                             |                         |     |                         |          |
| Analog-Signal Range                  | V <sub>COM-</sub> ,<br>V <sub>NO-</sub> | (Note 3)   |                             | V <sub>NN</sub> +<br>10 |     | V <sub>PP</sub> -<br>10 | V        |
| Small-Signal Switch<br>On-Resistance | R <sub>ONS</sub>                        | V <sub>PP</sub> = +40V,<br>V <sub>NN</sub> = -160V,<br>V <sub>COM-</sub> = 0V  | I <sub>COM</sub> = 5mA      | T <sub>A</sub> = 0°C    |     | 30                      | $\Omega$ |
|                                      |   |  |                             | T <sub>A</sub> = +25°C  | 26  | 38                      |          |
|                                      |   |  |                             | T <sub>A</sub> = +70°C  |     | 48                      |          |
|                                      |   |  | I <sub>COM</sub> =<br>200mA | T <sub>A</sub> = 0°C    |     | 25                      |          |
|                                      |   |  |                             | T <sub>A</sub> = +25°C  | 22  | 27                      |          |
|                                      |   |  |                             | T <sub>A</sub> = +70°C  |     | 32                      |          |
|                                      |   | V <sub>PP</sub> = +100V,<br>V <sub>NN</sub> = -100V,<br>V <sub>COM-</sub> = 0V | I <sub>COM</sub> = 5mA      | T <sub>A</sub> = 0°C    |     | 25                      |          |
|                                      |   |  |                             | T <sub>A</sub> = +25°C  | 22  | 27                      |          |
|                                      |   |  |                             | T <sub>A</sub> = +70°C  |     | 30                      |          |
|                                      |   |  | I <sub>COM</sub> =<br>200mA | T <sub>A</sub> = 0°C    |     | 18                      |          |
|                                      |   |  |                             | T <sub>A</sub> = +25°C  | 18  | 24                      |          |
|                                      |   |  |                             | T <sub>A</sub> = +70°C  |     | 27                      |          |

# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

MAX4800A/MAX4802A

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{DD} = +2.7V$  to  $+6V$ ,  $V_{PP} = +40V$  to  $(V_{NN} + 200V)$ ,  $V_{NN} = -40V$  to  $-160V$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .) (Note 2)

| PARAMETER                                  | SYMBOL                                  | CONDITIONS  |                     | MIN                 | TYP | MAX  | UNITS     |    |
|--|---|---|---------------------|---------------------|-----|------|-----------|----|
| Small-Signal Switch On-Resistance          | $R_{ONS}$                               | $V_{PP} = +160V$ ,<br>$V_{NN} = -40V$                                       | $I_{COM} = 5mA$     | $T_A = 0^\circ C$   |     | 23   | $\Omega$  |    |
|  |   |   |                     | $T_A = +25^\circ C$ |     | 20   |           | 25 |
|  |   |   |                     | $T_A = +70^\circ C$ |     |      |           | 30 |
|  |   |   | $I_{COM} = 200mA$   | $T_A = 0^\circ C$   |     |      |           | 22 |
|  |   |   |                     | $T_A = +25^\circ C$ |     | 16   |           | 25 |
|  |   |   |                     | $T_A = +70^\circ C$ |     |      |           | 27 |
| Small-Signal Switch On-Resistance Matching | $\Delta R_{ONS}$                        | $V_{PP} = +100V$ , $V_{NN} = -100V$ ,<br>$V_{COM\_} = 0V$ , $I_{COM} = 5mA$ |                     |                     | 5   | 20   | %         |    |
| Large-Signal Switch On-Resistance          | $R_{ONL}$                               | $V_{COM\_} = V_{PP} - 10V$ , $I_{COM} = 1A$                                 |                     |                     | 15  |      | $\Omega$  |    |
| Shunt Resistance (MAX4802A only)           | $R_{INT}$                               | NO_ or COM_ to RGND, switch off   |                     | 30                  | 35  | 50   | $k\Omega$ |    |
| Switch-Off Leakage                         | $I_{COM\_ (OFF)}$ ,<br>$I_{NO\_ (OFF)}$ | $V_{COM\_}$ , $V_{NO\_} = V_{PP} - 10V$ or unconnected;<br>(MAX4800A only)  |                     |                     | 0   | 2    | $\mu A$   |    |
|  |   |   |                     |                     |     | 10   |           |    |
| Switch-Off DC Offset                       |   | $R_L = 100k\Omega$ (MAX4800A),<br>no load (MAX4802A)                        |                     |                     | 0   | 10   | mV        |    |
| Switch-On DC Offset                        |   | $R_L = 100k\Omega$ (MAX4800A),<br>no load (MAX4802A)                        |                     |                     | 0   | 10   | mV        |    |
| Switch-Output Peak Current (Note 4)        |   | $I_{COM\_}$ duty cycle $\leq 0.1\%$   | $T_A = 0^\circ C$   | 3                   |     |      | A         |    |
|  |   |   | $T_A = +25^\circ C$ | 2                   | 3   |      |           |    |
|  |   |   | $T_A = +70^\circ C$ | 2                   |     |      |           |    |
| Switch-Output Isolation Diode Current      |   | 300ns pulse width, 2% duty cycle (Note 4)                                   |                     | 300                 |     |      | mA        |    |
| <b>SWITCH DYNAMIC CHARACTERISTICS</b>      |   |   |                     |                     |     |      |           |    |
| Off-Isolation (Note 4)                     | $V_{ISO}$                               | $f = 5MHz$ , $R_L = 1k\Omega$ , $C_L = 15pF$                                |                     | -30                 | -33 |      | dB        |    |
|  |   | $f = 5MHz$ , $R_L = 50\Omega$   |                     | -58                 | -77 |      |           |    |
| Crosstalk                                  | $V_{CT}$                                | $f = 5MHz$ , $R_L = 50\Omega$ (Note 4)                                      |                     | -60                 | -80 |      | dB        |    |
| COM_, NO_ Off-Capacitance                  | $C_{COM\_ (OFF)}$ ,<br>$C_{NO\_ (OFF)}$ | $V_{COM\_} = 0V$ , $V_{NO\_} = 0V$ , $f = 1MHz$ (Note 4)                    |                     | 4                   | 11  | 18   | pF        |    |
| COM_ On-Capacitance                        | $C_{COM\_ (ON)}$                        | $V_{COM\_} = 0V$ , $f = 1MHz$ (Note 4)                                      |                     | 20                  | 36  | 56   | pF        |    |
| Output Voltage Spike                       | $V_{SPK}$                               | $R_L = 50\Omega$ (Note 4)   |                     | -150                |     | +150 | mV        |    |
| Charge Injection (MAX4802A only)           | Q                                       | $V_{PP} = +40V$ , $V_{NN} = -160V$ , $V_{COM\_} = 0V$                       |                     |                     | 820 |      | pC        |    |
|  |   | $V_{PP} = +100V$ , $V_{NN} = -100V$ , $V_{COM\_} = 0V$                      |                     |                     | 600 |      |           |    |
|  |   | $V_{PP} = +160V$ , $V_{NN} = -40V$ , $V_{COM\_} = 0V$                       |                     |                     | 350 |      |           |    |
| <b>LOGIC LEVELS</b>                        |   |   |                     |                     |     |      |           |    |
| Logic-Input Low Voltage                    | $V_{IL}$                                |   |                     |                     |     | 0.75 | V         |    |
| Logic-Input High Voltage                   | $V_{IH}$                                |   |                     | $V_{DD} - 0.75$     |     |      | V         |    |

# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{DD} = +2.7V$  to  $+6V$ ,  $V_{PP} = +40V$  to ( $V_{NN} + 200V$ ),  $V_{NN} = -40V$  to  $-160V$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .) (Note 2)

| PARAMETER                         | SYMBOL    | CONDITIONS   |                                     | MIN                 | TYP | MAX            | UNITS   |
|-----------------------------------|-----------|--|-------------------------------------|---------------------|-----|----------------|---------|
| Logic Input Capacitance           | $C_{IN}$  | (Note 4)   |                                     |                     |     | 10             | pF      |
| Logic Input Leakage               | $I_{IN}$  |  |                                     | -1                  |     | +1             | $\mu A$ |
| DOUT Low Voltage                  | $V_{OL}$  | $I_{SINK} = 1mA$   |                                     |                     |     | 0.4            | V       |
| DOUT High Voltage                 | $V_{OH}$  | $I_{SOURCE} = 0.75mA$  |                                     | $V_{DD} - 0.5$      |     |                | V       |
| <b>POWER SUPPLIES</b>             |           |  |                                     |                     |     |                |         |
| $V_{DD}$ Supply Voltage           | $V_{DD}$  |  |                                     | 2.7                 |     | 6.0            | V       |
| $V_{PP}$ Supply Voltage           | $V_{PP}$  |  |                                     | 40                  |     | $V_{NN} + 200$ | V       |
| $V_{NN}$ Supply Voltage           | $V_{NN}$  |  |                                     | -160                |     | -15            | V       |
| $V_{DD}$ Supply Quiescent Current | $I_{DDQ}$ | $V_{IL} = 0V$ , $V_{IH} = V_{PSD}$ , $f_{CLK} = 0Hz$               |                                     |                     |     | 3              | $\mu A$ |
| $V_{DD}$ Supply Dynamic Current   | $I_{DD}$  | $V_{DD} = +5V$ , $V_{IL} = 0V$ , $V_{IH} = +5V$ , $f_{CLK} = 5MHz$ |                                     |                     |     | 2              | mA      |
| $V_{PP}$ Supply Quiescent Current | $I_{PPQ}$ | All switches remain on or off, $I_{COM\_}(ON) = 5mA$               |                                     |                     | 10  | 50             | $\mu A$ |
| $V_{PP}$ Supply Dynamic Current   | $I_{PP}$  | 50kHz output switching frequency with no load                      | $V_{PP} = +40V$ , $V_{NN} = -160V$  | $T_A = 0^\circ C$   |     | 6.5            | mA      |
|                                   |           |  |                                     | $T_A = +25^\circ C$ |     | 6.5            |         |
|                                   |           |  |                                     | $T_A = +70^\circ C$ |     | 6.5            |         |
|                                   |           |  | $V_{PP} = +100V$ , $V_{NN} = -100V$ | $T_A = 0^\circ C$   |     | 4.0            |         |
|                                   |           |  |                                     | $T_A = +25^\circ C$ |     | 4.0            |         |
|                                   |           |  |                                     | $T_A = +70^\circ C$ |     | 4.0            |         |
|                                   |           |  | $V_{PP} = +160V$ , $V_{NN} = -40V$  | $T_A = 0^\circ C$   |     | 4.0            |         |
|                                   |           |  |                                     | $T_A = +25^\circ C$ |     | 4.0            |         |
|                                   |           |  |                                     | $T_A = +70^\circ C$ |     | 4.0            |         |
| $V_{NN}$ Supply Quiescent Current | $I_{NNQ}$ | All switches remain on or off, $I_{COM\_}(ON) = 5mA$               |                                     |                     | 10  | 50             | $\mu A$ |
| $V_{NN}$ Supply Dynamic Current   | $I_{NN}$  | 50kHz output switching frequency with no load                      | $V_{PP} = +40V$ , $V_{NN} = -160V$  | $T_A = 0^\circ C$   |     | 6.5            | mA      |
|                                   |           |  |                                     | $T_A = +25^\circ C$ |     | 6.5            |         |
|                                   |           |  |                                     | $T_A = +70^\circ C$ |     | 6.5            |         |
|                                   |           |  | $V_{PP} = +100V$ , $V_{NN} = -100V$ | $T_A = 0^\circ C$   |     | 4.0            |         |
|                                   |           |  |                                     | $T_A = +25^\circ C$ |     | 4.0            |         |
|                                   |           |  |                                     | $T_A = +70^\circ C$ |     | 4.0            |         |
|                                   |           |  | $V_{PP} = +160V$ , $V_{NN} = -40V$  | $T_A = 0^\circ C$   |     | 4.0            |         |
|                                   |           |  |                                     | $T_A = +25^\circ C$ |     | 4.0            |         |
|                                   |           |  |                                     | $T_A = +70^\circ C$ |     | 4.0            |         |

# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

MAX4800A/MAX4802A

## TIMING CHARACTERISTICS

( $V_{DD} = +2.7V$  to  $+6V$ ,  $V_{PP} = +40V$  to  $(V_{NN} + 200V)$ ,  $V_{NN} = -40V$  to  $-160V$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .) (Note 2)

| PARAMETER                                  | SYMBOL     | CONDITIONS   | MIN                     | TYP | MAX | UNITS   |
|--|------------|--|-------------------------|-----|-----|---------|
| <b>ANALOG SWITCH</b>                       |            |  |                         |     |     |         |
| Turn-On Time                               | $t_{ON}$   | $V_{NO\_} = V_{PP} - 10V$ , $R_L = 10k\Omega$ , $V_{NN} = -40V$ to $-160V$ |                         |     | 5   | $\mu s$ |
| Turn-Off Time                              | $t_{OFF}$  | $V_{NO\_} = V_{PP} - 10V$ , $R_L = 10k\Omega$ , $V_{NN} = -40V$ to $-160V$ |                         |     | 5   | $\mu s$ |
| Output Switching Frequency                 | $f_{SW}$   | Duty cycle = 50%   |                         |     | 50  | kHz     |
| Maximum $V_{COM\_}$ , $V_{NO\_}$ Slew Rate | $dV/dt$    | (Note 4)   | 20                      |     |     | V/ns    |
| <b>LOGIC TIMING</b> (Figure 1)             |            |  |                         |     |     |         |
| CLK Frequency                              | $f_{CLK}$  | Daisy chaining   | $V_{DD} = +5V \pm 10\%$ |     | 20  | MHz     |
|  |            |  | $V_{DD} = +3V \pm 10\%$ |     | 10  |         |
| DIN to CLK Setup Time                      | $t_{DS}$   | $V_{DD} = +5V \pm 10\%$  |                         |     | 10  | ns      |
|  |            | $V_{DD} = +3V \pm 10\%$  |                         |     | 16  |         |
| DIN to CLK Hold Time                       | $t_{DH}$   | $V_{DD} = +5V \pm 10\%$  | 3                       |     |     | ns      |
|  |            | $V_{DD} = +3V \pm 10\%$  | 3                       |     |     |         |
| CLK to $\overline{LE}$ Setup Time          | $t_{CS}$   | $V_{DD} = +5V \pm 10\%$  | 36                      |     |     | ns      |
|  |            | $V_{DD} = +3V \pm 10\%$  | 65                      |     |     |         |
| $\overline{LE}$ Low Pulse Width            | $t_{WL}$   | $V_{DD} = +5V \pm 10\%$  | 14                      |     |     | ns      |
|  |            | $V_{DD} = +3V \pm 10\%$  | 22                      |     |     |         |
| CLR High Pulse Width                       | $t_{WC}$   | $V_{DD} = +5V \pm 10\%$  | 20                      |     |     | ns      |
|  |            | $V_{DD} = +3V \pm 10\%$  | 40                      |     |     |         |
| CLK Rise and Fall Times (Note 4)           | $t_R, t_F$ | $V_{DD} = +5V \pm 10\%$  |                         |     | 50  | ns      |
|  |            | $V_{DD} = +3V \pm 10\%$  |                         |     | 50  |         |
| CLK to DOUT Delay                          | $t_{DO}$   | $V_{DD} = +5V \pm 10\%$ , $C_L \leq 20pF$                                  | 6                       |     | 42  | ns      |
|  |            | $V_{DD} = +3V \pm 10\%$ , $C_L \leq 20pF$                                  | 12                      |     | 80  |         |

**Note 2:** Specifications at  $0^\circ C$  are guaranteed by correlation and design.

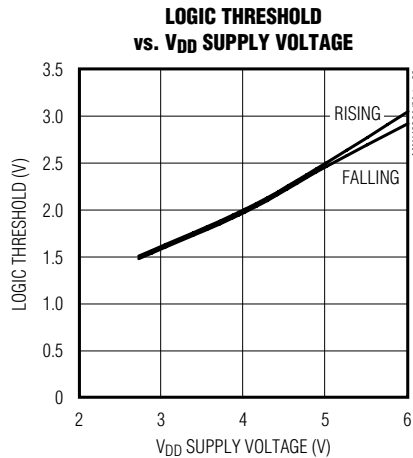
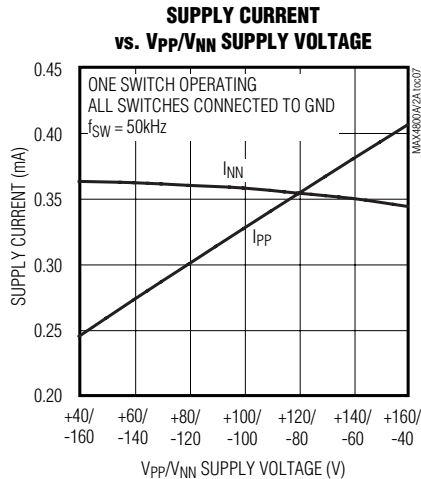
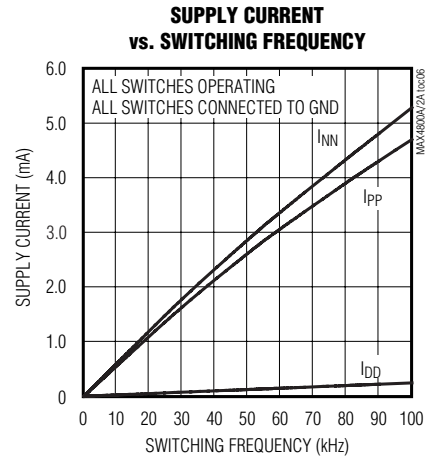
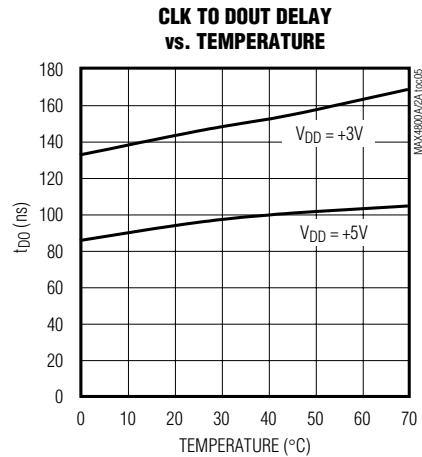
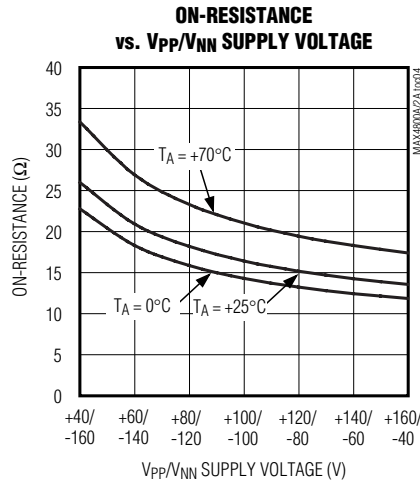
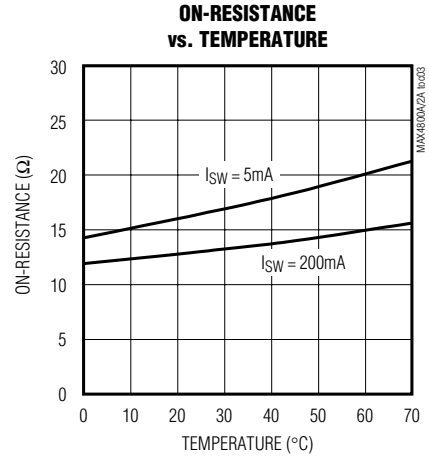
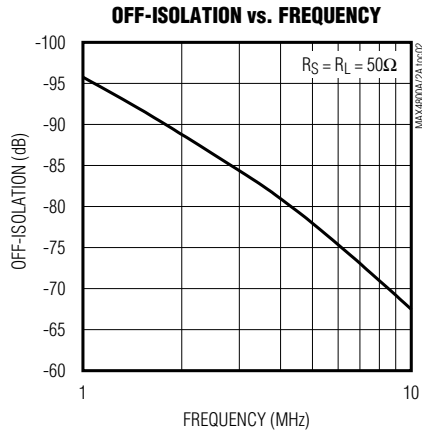
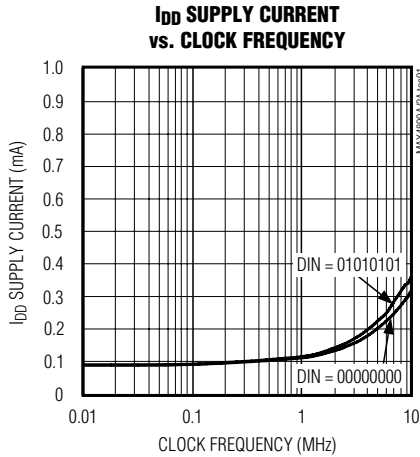
**Note 3:** The analog-signal input  $V_{COM\_}$  and  $V_{NO\_}$  must satisfy  $V_{NN} \leq (V_{COM\_}, V_{NO\_}) \leq V_{PP}$ , or remain unconnected during power-up and power-down.

**Note 4:** Guaranteed by design and characterization; not production tested.

# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

## Typical Operating Characteristics

( $V_{DD} = +5V$ ,  $V_{PP} = +100V$ ,  $V_{NN} = -100V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)



# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

## Pin/Bump Descriptions

**MAX4800A/MAX4802A**

| PIN/BUMP   |                   |                  | NAME                   | FUNCTION   |
|--|-------------------|------------------|------------------------|--|
| MAX4800A<br>LQFP   | MAX4800A<br>CSBGA | MAX4800A<br>PLCC |                        |  |
| 1  | E4                | 26               | COM5                   | Analog Switch 5—Common Terminal  |
| 2, 4, 6, 7, 9,<br>11, 13, 15, 17,<br>19, 21, 23, 26,<br>27, 30, 31, 32,<br>38, 40, 42, 44,<br>46, 48 | D6                | 9, 11, 15        | N.C.                   | No Connection. Not connected internally.   |
| 3  | E1                | 27               | COM4                   | Analog Switch 4—Common Terminal  |
| 5  | E3                | 28               | NO4                    | Analog Switch 4—Normally Open Terminal   |
| 8  | D1                | 1                | COM3                   | Analog Switch 3—Common Terminal  |
| 10   | D3                | 2                | NO3                    | Analog Switch 3—Normally Open Terminal   |
| 12   | D4                | 3                | COM2                   | Analog Switch 2—Common Terminal  |
| 14   | C3                | 4                | NO2                    | Analog Switch 2—Normally Open Terminal   |
| 16   | C4                | 5                | COM1                   | Analog Switch 1—Common Terminal  |
| 18   | A4                | 6                | NO1                    | Analog Switch 1—Normally Open Terminal   |
| 20   | C5                | 7                | COM0                   | Analog Switch 0—Common Terminal  |
| 22   | D5                | 8                | NO0                    | Analog Switch 0—Normally Open Terminal   |
| 24   | C6                | 10               | V <sub>PP</sub>        | Positive High-Voltage Supply. Bypass V <sub>PP</sub> to GND with a 0.1μF or greater ceramic capacitor. |
| 25   | C7                | 12               | V <sub>NN</sub>        | Negative High-Voltage Supply. Bypass V <sub>NN</sub> to GND with a 0.1μF or greater ceramic capacitor. |
| 28   | D7                | 13               | GND                    | Ground   |
| 29   | D9                | 14               | V <sub>DD</sub>        | Digital Supply Voltage. Bypass V <sub>DD</sub> to GND with a 0.1μF or greater ceramic capacitor.       |
| 33   | E9                | 16               | DIN                    | Serial-Data Input  |
| 34   | E7                | 17               | CLK                    | Serial-Clock Input   |
| 35   | E6                | 18               | $\overline{\text{LE}}$ | Latch-Enable Input, Active Low   |
| 36   | F7                | 19               | CLR                    | Latch Clear Input  |
| 37   | F6                | 20               | DOUT                   | Serial-Data Output   |
| 39   | E5                | 21               | COM7                   | Analog Switch 7—Common Terminal  |
| 41   | F5                | 22               | NO7                    | Analog Switch 7—Normally Open Terminal   |
| 43   | F4                | 23               | COM6                   | Analog Switch 6—Common Terminal  |
| 45   | H4                | 24               | NO6                    | Analog Switch 6—Normally Open Terminal   |
| 47   | F3                | 25               | NO5                    | Analog Switch 5—Normally Open Terminal   |

# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

## Pin/Bump Descriptions (continued)

| PIN/BUMP  |                   |                  | NAME                   | FUNCTION   |
|---|-------------------|------------------|------------------------|--|
| MAX4802A<br>LQFP  | MAX4802A<br>CSBGA | MAX4802A<br>PLCC |                        |  |
| 1   | E4                | 26               | COM5                   | Analog Switch 5—Common Terminal  |
| 2, 4, 6, 7, 9,<br>11,13, 15, 17,<br>19, 21, 23, 26,<br>30, 31, 32, 38,<br>40, 42, 44, 46,<br>48 | —                 | 9, 15            | N.C.                   | No Connection. Not connected internally.   |
| 3   | E1                | 27               | COM4                   | Analog Switch 4—Common Terminal  |
| 5   | E3                | 28               | NO4                    | Analog Switch 4—Normally Open Terminal   |
| 8   | D1                | 1                | COM3                   | Analog Switch 3—Common Terminal  |
| 10  | D3                | 2                | NO3                    | Analog Switch 3—Normally Open Terminal   |
| 12  | D4                | 3                | COM2                   | Analog Switch 2—Common Terminal  |
| 14  | C3                | 4                | NO2                    | Analog Switch 2—Normally Open Terminal   |
| 16  | C4                | 5                | COM1                   | Analog Switch 1—Common Terminal  |
| 18  | A4                | 6                | NO1                    | Analog Switch 1—Normally Open Terminal   |
| 20  | C5                | 7                | COM0                   | Analog Switch 0—Common Terminal  |
| 22  | D5                | 8                | NO0                    | Analog Switch 0—Normally Open Terminal   |
| 24  | C6                | 10               | V <sub>PP</sub>        | Positive High-Voltage Supply. Bypass V <sub>PP</sub> to GND with a 0.1μF or greater ceramic capacitor. |
| 25  | C7                | 12               | V <sub>NN</sub>        | Negative High-Voltage Supply. Bypass V <sub>NN</sub> to GND with a 0.1μF or greater ceramic capacitor. |
| 27  | D6                | 11               | RGND                   | Bleed Resistor Ground  |
| 28  | D7                | 13               | GND                    | Ground   |
| 29  | D9                | 14               | V <sub>DD</sub>        | Digital Supply Voltage. Bypass V <sub>DD</sub> to GND with a 0.1μF or greater ceramic capacitor.       |
| 33  | E9                | 16               | DIN                    | Serial-Data Input  |
| 34  | E7                | 17               | CLK                    | Serial-Clock Input   |
| 35  | E6                | 18               | $\overline{\text{LE}}$ | Latch-Enable Input, Active Low   |
| 36  | F7                | 19               | CLR                    | Latch Clear Input  |
| 37  | F6                | 20               | DOUT                   | Serial-Data Output   |
| 39  | E5                | 21               | COM7                   | Analog Switch 7—Common Terminal  |
| 41  | F5                | 22               | NO7                    | Analog Switch 7—Normally Open Terminal   |
| 43  | F4                | 23               | COM6                   | Analog Switch 6—Common Terminal  |
| 45  | H4                | 24               | NO6                    | Analog Switch 6—Normally Open Terminal   |
| 47  | F3                | 25               | NO5                    | Analog Switch 5—Normally Open Terminal   |



# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

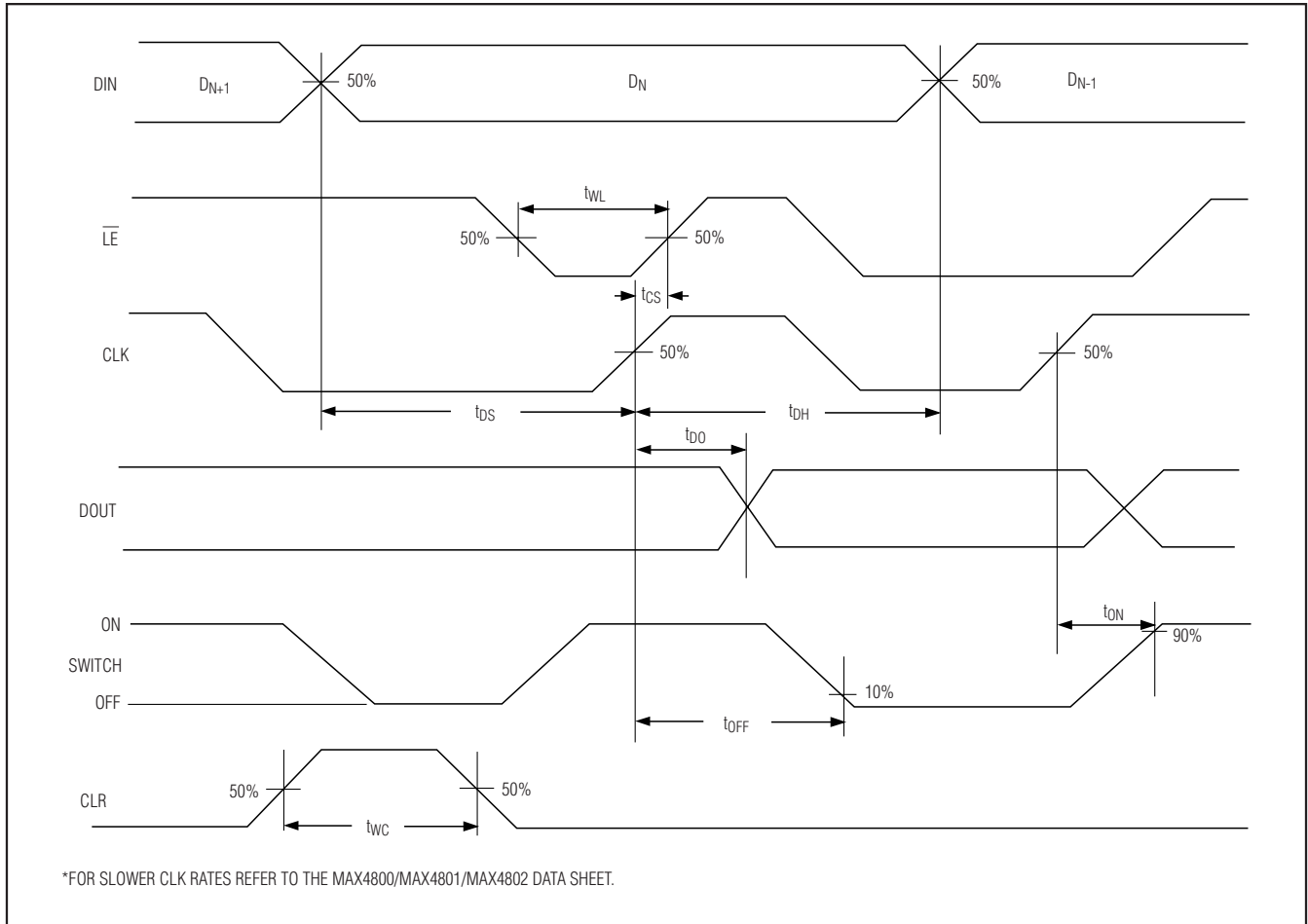


Figure 1. Serial Interface Timing\*

## Detailed Description

The MAX4800A/MAX4802A provide high-voltage switching on eight channels for ultrasound imaging and printer applications. The devices utilize BCDMOS process technology to provide eight high-voltage low-charge-injection SPST switches, controlled by a 20MHz serial interface. Data is clocked into an internal 8-bit shift register and retained by a programmable latch with enable and clear inputs. A power-on reset function ensures that all switches are open on power-up.

The devices operate with a wide range of high-voltage supplies including:  $V_{PP}/V_{NN} = +100V/-100V$ ,  $+185V/-15V$ , or  $+40V/-160V$ . The digital interface operates from a separate  $V_{DD}$  supply from  $+2.7V$  to  $+6V$ . Digital inputs DIN, CLK,  $\overline{LE}$ , and CLR are  $+6V$  tolerant, independent of the  $V_{DD}$  supply voltage. The MAX4802A

provides integrated  $35k\Omega$  bleed resistors on each switch terminal to discharge capacitive loads.

The devices are drop-in replacements for the Supertex HV2203 and HV2303, respectively.

### Analog Switch

The devices allow a peak-to-peak analog-signal range from  $V_{NN} + 10V$  to  $V_{PP} - 10V$ . Analog switch inputs must be unconnected, or satisfy  $V_{NN} \leq (V_{COM\_}, V_{NO\_}) \leq V_{PP}$  during power-up and power-down.

### High-Voltage Supplies

The devices allow a wide range of high-voltage supplies. The devices operate with  $V_{NN}$  from  $-160V$  to  $-15V$  and  $V_{PP}$  from  $+40V$  to  $(V_{NN} + 200V)$ . When  $V_{NN}$  is connected to GND (single-supply applications), the devices operate with  $V_{pp}$  up to  $+200V$ .

# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

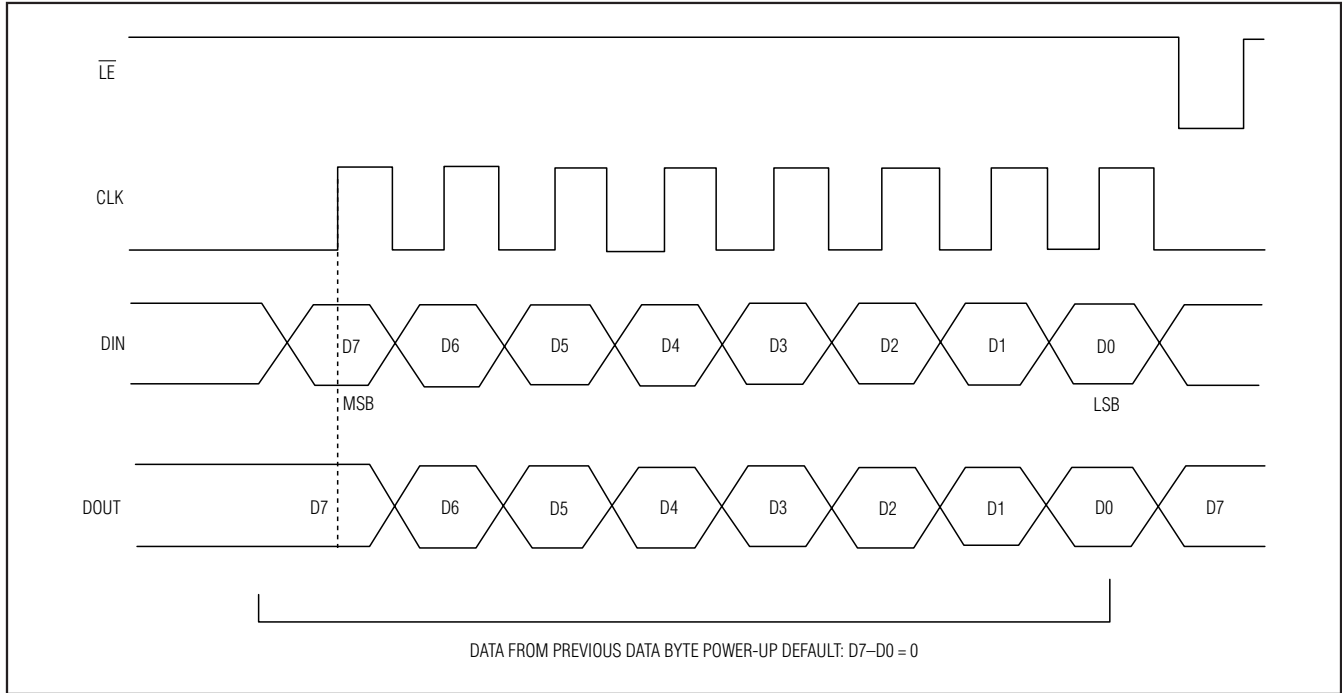


Figure 2. Latch-Enable Interface Timing

The  $V_{PP}$  and  $V_{NN}$  high-voltage supplies are not required to be symmetrical, but the voltage difference  $V_{PP} - V_{NN}$  must not exceed 200V.

### Bleed Resistors (MAX4802A)

The MAX4802A features integrated 35k $\Omega$  bleed resistors to discharge capacitive loads such as piezoelectric transducers. Each analog-switch terminal is connected to RGND with a bleed resistor.

### Serial Interface

The devices are controlled by a serial interface with an 8-bit serial shift register and transparent latch. Each of the eight data bits controls a single analog switch (see Table 1). Data on DIN is clocked with the most significant bit (MSB) first into the shift register on the rising edge of CLK. Data is clocked out of the shift register onto DOUT on the rising edge of CLK. DOUT reflects the status of DIN, delayed by eight clock cycles (see Figures 1 and 2).

### Latch Enable ( $\overline{LE}$ )

Drive  $\overline{LE}$  logic-low to change the contents of the latch and update the state of the high-voltage switches (Figure 2). Drive  $\overline{LE}$  logic-high to freeze the contents of the latch and prevent changes to the switch states. To reduce noise due to clock feedthrough, drive  $\overline{LE}$  logic-high while data is clocked into the shift register. After the data shift register is loaded with valid data, pulse  $\overline{LE}$  logic-low to load the contents of the shift register into the latch.

### Latch Clear (CLR)

The devices feature a latch clear input. Drive CLR logic-high to reset the contents of the latch to zero and open all switches. CLR does not affect the contents of the data shift register. Pulse  $\overline{LE}$  logic-low to reload the contents of the shift register into the latch.

### Power-On Reset

The devices feature a power-on reset circuit to ensure all switches are open at power-on. The internal 8-bit serial shift register and latch are set to zero on power-up.

# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

Table 1. Serial Interface Programming

| DATA BITS |    |    |    |    |    |    |          | CONTROL BITS    |     | FUNCTION            |     |     |     |     |     |     |     |     |
|-----------|----|----|----|----|----|----|----------|-----------------|-----|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| D0 (LSB)  | D1 | D2 | D3 | D4 | D5 | D6 | D7 (MSB) | $\overline{LE}$ | CLR | SW0                 | SW1 | SW2 | SW3 | SW4 | SW5 | SW6 | SW7 |     |
| L         |    |    |    |    |    |    |          | L               | L   | Off                 |     |     |     |     |     |     |     |     |
| H         |    |    |    |    |    |    |          | L               | L   | On                  |     |     |     |     |     |     |     |     |
|           | L  |    |    |    |    |    |          | L               | L   |                     | Off |     |     |     |     |     |     |     |
|           | H  |    |    |    |    |    |          | L               | L   |                     | On  |     |     |     |     |     |     |     |
|           |    | L  |    |    |    |    |          | L               | L   |                     |     | Off |     |     |     |     |     |     |
|           |    | H  |    |    |    |    |          | L               | L   |                     |     | On  |     |     |     |     |     |     |
|           |    |    | L  |    |    |    |          | L               | L   |                     |     |     | Off |     |     |     |     |     |
|           |    |    | H  |    |    |    |          | L               | L   |                     |     |     | On  |     |     |     |     |     |
|           |    |    |    | L  |    |    |          | L               | L   |                     |     |     |     | Off |     |     |     |     |
|           |    |    |    | H  |    |    |          | L               | L   |                     |     |     |     | On  |     |     |     |     |
|           |    |    |    |    | L  |    |          | L               | L   |                     |     |     |     |     | Off |     |     |     |
|           |    |    |    |    | H  |    |          | L               | L   |                     |     |     |     |     | On  |     |     |     |
|           |    |    |    |    |    | L  |          | L               | L   |                     |     |     |     |     |     | Off |     |     |
|           |    |    |    |    |    | H  |          | L               | L   |                     |     |     |     |     |     | On  |     |     |
|           |    |    |    |    |    |    | L        | L               | L   |                     |     |     |     |     |     |     | Off |     |
|           |    |    |    |    |    |    | H        | L               | L   |                     |     |     |     |     |     |     | On  |     |
| X         | X  | X  | X  | X  | X  | X  | X        | H               | L   | Hold Previous State |     |     |     |     |     |     |     |     |
| X         | X  | X  | X  | X  | X  | X  | X        | X               | H   | Off                 | Off | Off | Off | Off | Off | Off | Off | Off |

X = Don't care.

## Applications Information

### Logic Levels

The devices' digital interface inputs CLK, DIN,  $\overline{LE}$ , and CLR are tolerant of up to +6V, independent of the V<sub>DD</sub> supply voltage, allowing compatibility with higher voltage controllers.

### Daisy Chaining Multiple Devices

Digital output DOUT is provided to allow the connection of multiple devices by daisy-chaining (Figure 3). Connect each DOUT to the DIN of the subsequent device in the chain. Connect CLK,  $\overline{LE}$ , and CLR inputs of all devices, and drive  $\overline{LE}$  logic-low to update all devices simultaneously. Drive CLR high to open all the switches simultaneously. Additional shift registers may be included anywhere in series with the MAX4800A/MAX4802A data chain.

## Supply Sequencing and Bypassing

The devices do not require special sequencing of the V<sub>DD</sub>, V<sub>PP</sub>, and V<sub>NN</sub> supply voltages; however, analog switch inputs must be unconnected, or satisfy V<sub>NN</sub> ≤ (V<sub>COM\_</sub>, V<sub>NO\_</sub>) ≤ V<sub>PP</sub> during power-up and power-down. Bypass V<sub>DD</sub>, V<sub>NN</sub>, and V<sub>PP</sub> to GND with a 0.1μF ceramic capacitor as close to the device as possible.

## Chip Information

PROCESS: BCDMOS

# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

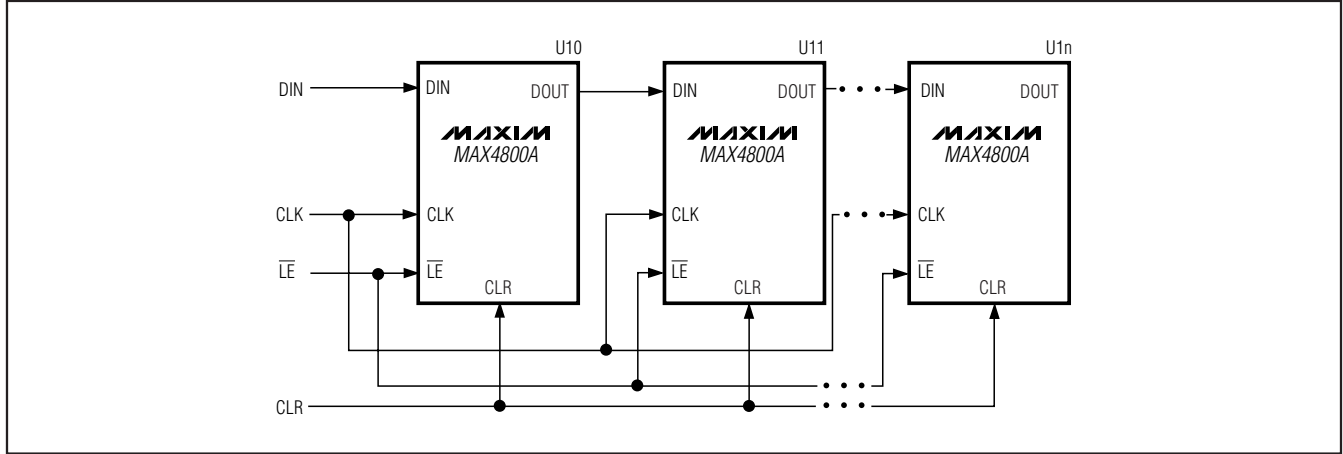
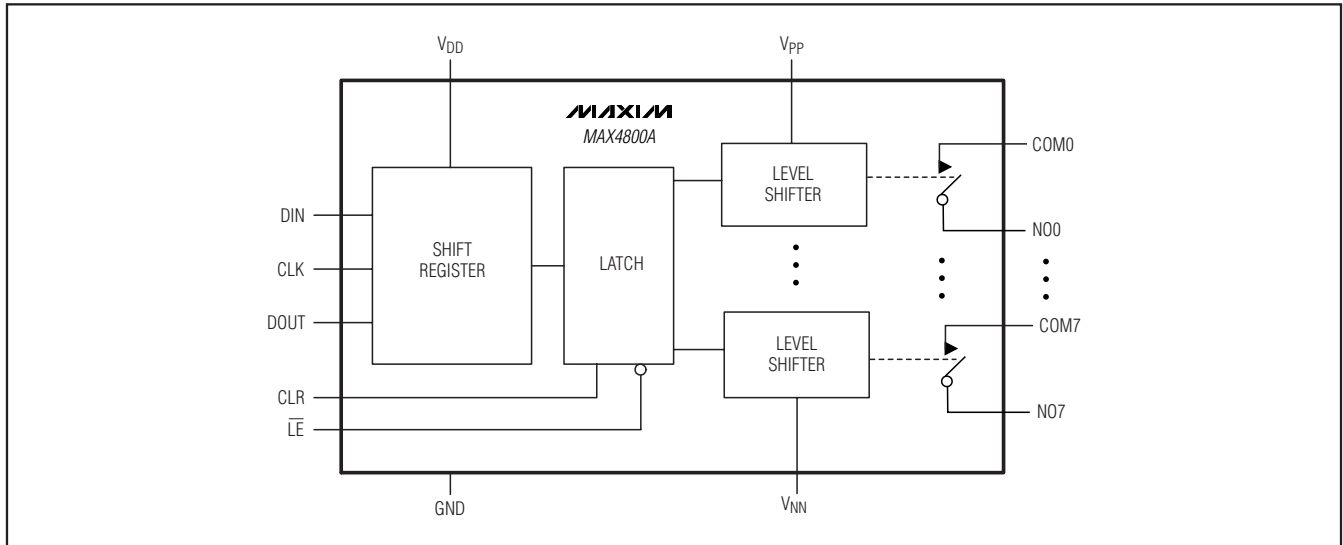


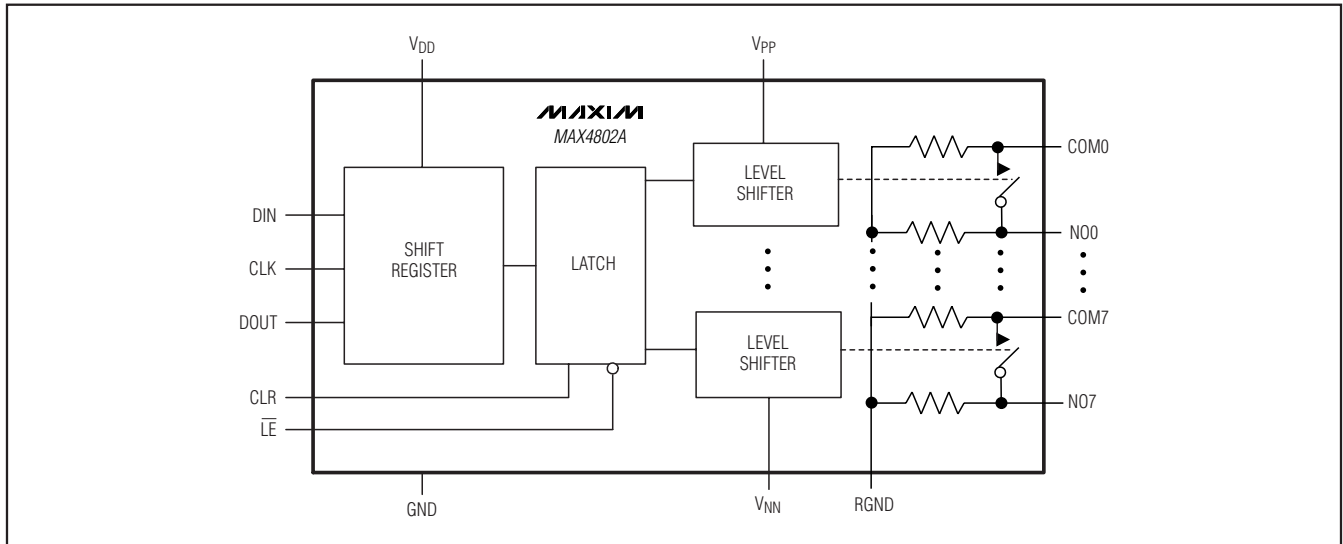
Figure 3. Interfacing Multiple Devices by Daisy-Chaining

## Functional Diagrams



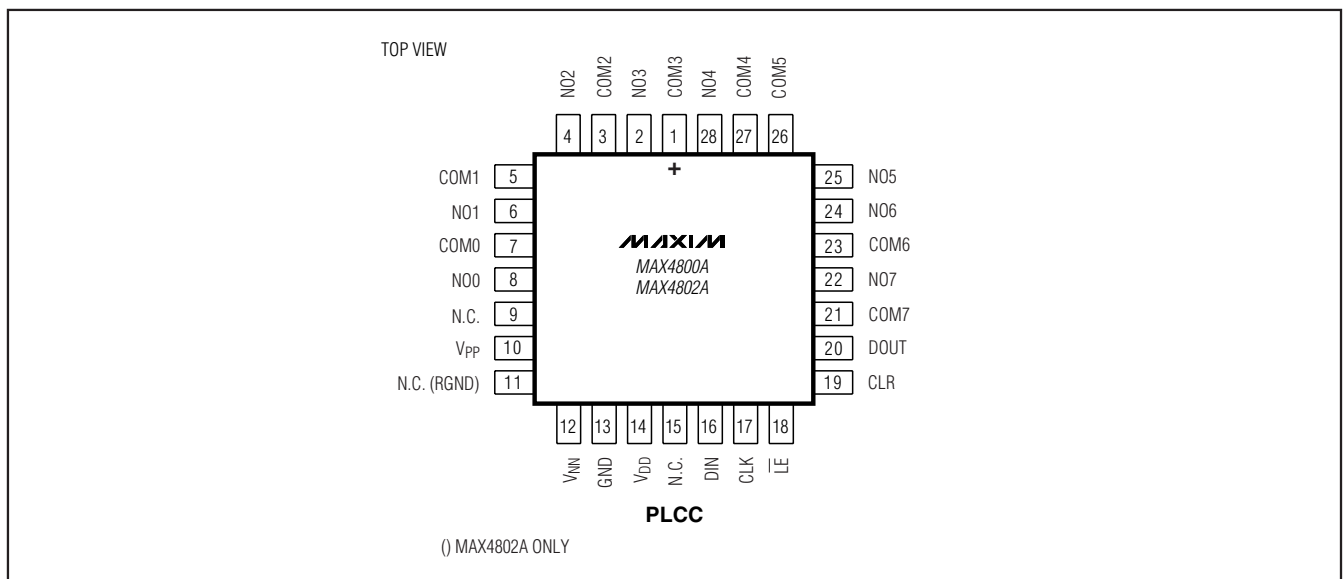
# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

## Functional Diagrams (continued)



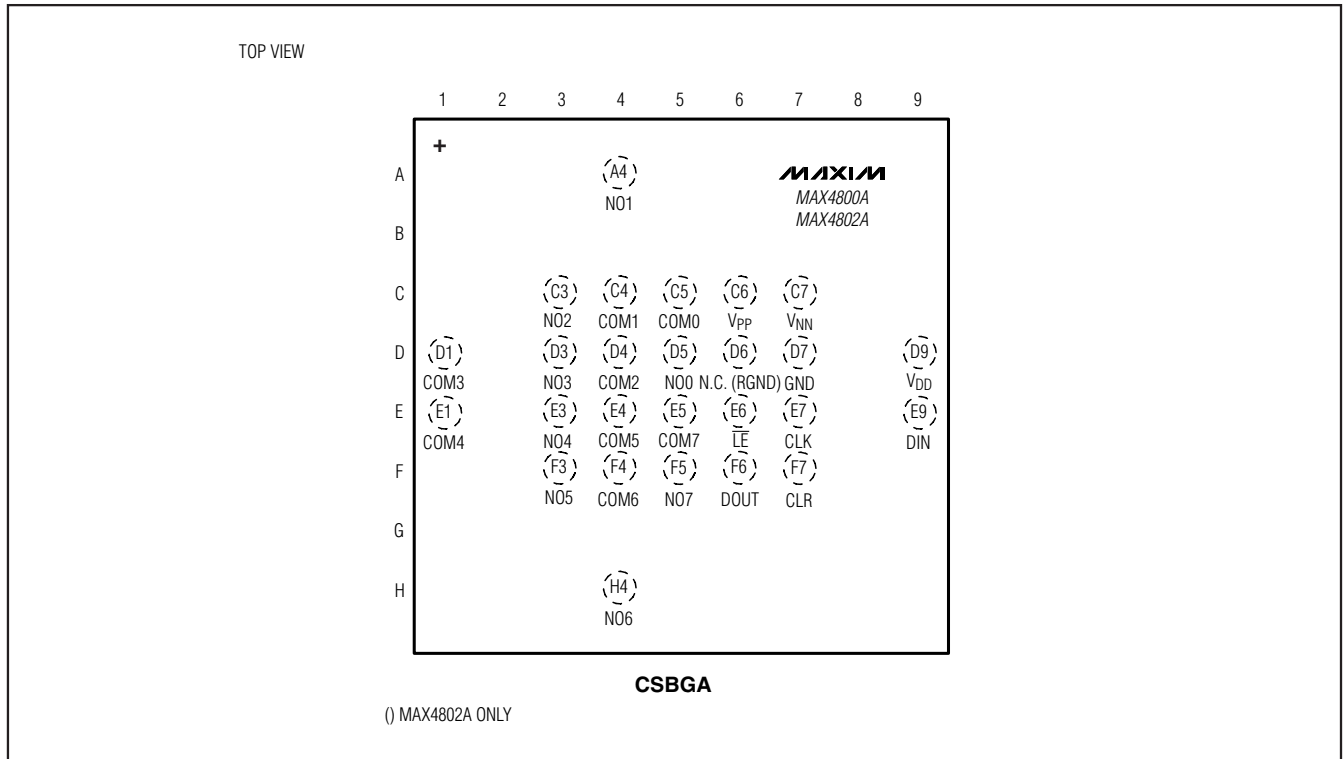
**MAX4800A/MAX4802A**

## Pin/Bump Configurations (continued)



# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

## Pin/Bump Configurations (continued)



## Package Information

For the latest package outline information and land patterns (footprints), go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

| PACKAGE TYPE | PACKAGE CODE | OUTLINE NO.             | LAND PATTERN NO.        |
|--------------|--------------|-------------------------|-------------------------|
| 26 CSBGA     | X07265+1     | <a href="#">21-0158</a> | <a href="#">90-0184</a> |
| 28 PLCC      | Q28+13       | <a href="#">21-0049</a> | <a href="#">90-0235</a> |
| 48 LQFP      | C48+6        | <a href="#">21-0054</a> | <a href="#">90-0093</a> |

# Low-Charge-Injection, 8-Channel, High-Voltage Analog Switches with 20MHz Serial Interface

## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION   | PAGES CHANGED |
|-----------------|---------------|---|---------------|
| 0               | 5/08          | Initial release   | —             |
| 1               | 2/11          | Changed the DC analog-signal frequency range to 50MHz in the <i>Features</i> section; changed the TQFP package to LQFP in the <i>General Description</i> , <i>Ordering Information</i> , <i>Features</i> , <i>Pin/Bump Configurations</i> , <i>Pin/Bump Descriptions</i> , and <i>Package Information</i> | 1, 8, 14      |

MAX4800A/MAX4802A

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