



# 50Ω, Dual SPST Analog Switches in UCSP

## General Description

The MAX4731/MAX4732/MAX4733 low-voltage, dual, single-pole/single-throw (SPST) analog switches operate from a single +2V to +11V supply and handle rail-to-rail analog signals. These switches exhibit low leakage current (0.1nA) and consume less than 0.5nW (typ) of quiescent power, making them ideal for battery-powered applications.

When powered from a +3V supply, these switches feature 50Ω (max) on-resistance ( $R_{ON}$ ) with 3.5Ω (max) matching between channels, and 9Ω (max) flatness over the specified signal range.

The MAX4731 has two normally open (NO) switches, the MAX4732 has two normally closed (NC) switches, and the MAX4733 has one NO and one NC switch. The MAX4731/MAX4732/MAX4733 are available in 9-bump chip-scale packages (UCSP™), along with 8-pin TDFN and 8-pin μMAX® packages. The tiny UCSP occupies a 1.52mm × 1.52mm area and significantly reduces the required PC board area.

## Applications

Battery-Powered Systems  
Audio/Video-Signal Routing  
Low-Voltage Data-Acquisition Systems  
Cell Phones  
Communications Circuits  
PDAs

## Features

- ◆ 1.52mm × 1.52mm UCSP Package
- ◆ Guaranteed On-Resistance ( $R_{ON}$ )  
25Ω (max) at +5V  
50Ω (max) at +3V
- ◆ On-Resistance Matching  
3Ω (max) at +5V  
3.5Ω (max) at +3V
- ◆ Guaranteed < 0.1nA Leakage Current at  
 $T_A = +25^\circ\text{C}$
- ◆ Single-Supply Operation from +2.0V to +11V
- ◆ TTL/CMOS-Logic Compatible
- ◆ -108dB Crosstalk (1MHz)
- ◆ -72dB Off-Isolation (1MHz)
- ◆ Low Power Consumption: 0.5nW (typ)
- ◆ Rail-to-Rail Signal Handling

## Ordering Information

| PART        | TEMP RANGE     | PIN/BUMP-PACKAGE | TOP MARK |
|-------------|----------------|------------------|----------|
| MAX4731EUA  | -40°C to +85°C | 8 μMAX           | —        |
| MAX4731ETA  | -40°C to +85°C | 8 TDFN-EP**      | ALG      |
| MAX4731EBL- | -40°C to +85°C | 9 UCSP-9         | ABV      |
| MAX4732EUA  | -40°C to +85°C | 8 μMAX           | —        |
| MAX4732ETA  | -40°C to +85°C | 8 TDFN-EP**      | ALH      |
| MAX4732EBL- | -40°C to +85°C | 9 UCSP-9         | ABT      |
| MAX4733EUA  | -40°C to +85°C | 8 μMAX           | —        |
| MAX4733ETA  | -40°C to +85°C | 8 TDFN-EP**      | ALI      |
| MAX4733EBL- | -40°C to +85°C | 9 UCSP-9         | ABS      |

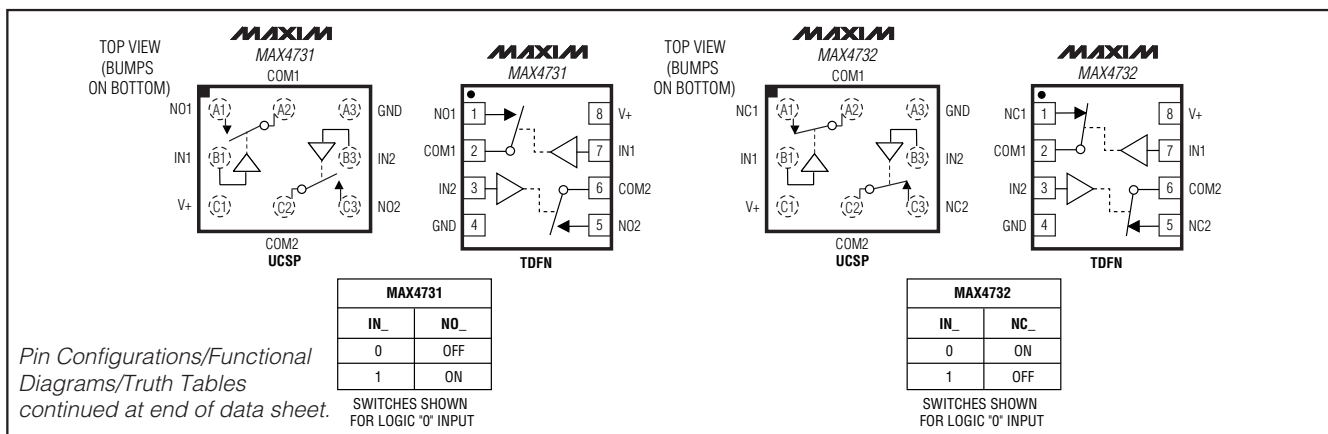
UCSP is a trademark of Maxim Integrated Products, Inc.

μMAX is a registered trademark of Maxim Integrated Products, Inc.

\*Future product—contact factory for availability.

\*\*EP = Exposed pad.

## Pin Configurations/Functional Diagrams/Truth Tables



# 50Ω, Dual SPST Analog Switches in UCSP

## ABSOLUTE MAXIMUM RATINGS

(All voltages referenced to GND.)

|                                                       |                           |
|-------------------------------------------------------|---------------------------|
| V+                                                    | .....-0.3V to +12V        |
| IN_, COM_, NO_, NC_ (Note 1)                          | .....-0.3V to (V+ + 0.3V) |
| Continuous Current (any pin)                          | .....±10mA                |
| Peak Current (any pin, pulsed at 1ms, 10% duty cycle) | ...±20mA                  |
| Continuous Power Dissipation (T <sub>A</sub> = +70°C) |                           |
| 8-Pin μMAX (derate 4.5mW/°C above +70°C)              | .....362mW                |
| 8-Pin TDFN (derate 24.4mW/°C above +70°C)             | .....1951mW               |
| 9-Bump UCSP (derate 4.7mW/°C above +70°C)             | .....379mW                |

|                                      |                      |
|--------------------------------------|----------------------|
| Operating Temperature Range          | .....-40°C to +85°C  |
| Storage Temperature Range            | .....-65°C to +150°C |
| Maximum Junction Temperature         | .....+150°C          |
| Lead Temperature (soldering, 10s)    | .....+300°C          |
| Bump Temperature (soldering, Note 2) |                      |
| Infrared (15s)                       | .....+220°C          |
| Vapor Phase (60s)                    | .....+215°C          |

**Note 1:** Signals on IN\_, NO\_, NC\_, or COM\_ exceeding V+ or GND are clamped by internal diodes. Limit forward-diode current to maximum current rating.

**Note 2:** This device is constructed using a unique set of packaging techniques that impose a limit on the thermal profile the device can be exposed to during board level solder attach and rework. This limit permits only the use of the solder profiles recommended in the industry-standard specification, JEDEC 020A, paragraph 7.6, Table 3 for IR/VPF and Convection reflow. Pre-heating is required. Hand or wave soldering is not allowed.

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—Single +3V Supply

(V+ = +3V ±10%, V<sub>IH</sub> = +2.0V, V<sub>IL</sub> = +0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V+ = +3V, T<sub>A</sub> = +25°C.) (Notes 3, 4)

| PARAMETER                                               | SYMBOL                                                     | CONDITIONS                                                                                                            | T <sub>A</sub>                                   | MIN        | TYP        | MAX        | UNITS |
|---------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|------------|------------|------------|-------|
| <b>ANALOG SWITCH</b>                                    |                                                            |                                                                                                                       |                                                  |            |            |            |       |
| Analog Signal Range                                     | V <sub>COM_</sub> ,<br>V <sub>NO_</sub> , V <sub>NC_</sub> |                                                                                                                       |                                                  | 0          |            | V+         | V     |
| On-Resistance                                           | R <sub>ON</sub>                                            | V+ = +2.7V,<br>I <sub>COM_</sub> = 5mA;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +1.5V                               | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> |            | 19<br>60   | 50         | Ω     |
| On-Resistance Matching<br>Between Channels (Notes 5, 6) | ΔR <sub>ON</sub>                                           | V+ = +2.7V,<br>I <sub>COM_</sub> = 5mA;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +1.5V                               | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> |            | 0.8<br>4.5 | 3.5        | Ω     |
| On-Resistance Flatness<br>(Note 7)                      | R <sub>FLAT(ON)</sub>                                      | V+ = +2.7V,<br>I <sub>COM_</sub> = 5mA;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +1V, +1.5V, +2V                     | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> |            | 2.3<br>11  | 9          | Ω     |
| NO_ or NC_ Off-Leakage Current<br>(Note 8)              | I <sub>NO_(OFF)</sub><br>I <sub>NC_(OFF)</sub>             | V+ = +3.6V,<br>V <sub>COM_</sub> = +0.3V, +3V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +3V, +0.3V                   | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -0.1<br>-2 |            | +0.1<br>+2 | nA    |
| COM_ Off-Leakage Current<br>(Note 8)                    | I <sub>COM_(OFF)</sub>                                     | V+ = +3.6V,<br>V <sub>COM_</sub> = +0.3V, +3V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +3V, +0.3V                   | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -0.1<br>-2 |            | +0.1<br>+2 | nA    |
| COM_ On-Leakage Current<br>(Note 8)                     | I <sub>COM_(ON)</sub>                                      | V+ = +3.6V,<br>V <sub>COM_</sub> = +0.3V, +3.0V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +0.3V, +3V, or<br>floating | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -0.2<br>-4 |            | +0.2<br>+4 | nA    |

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MAX4731/MAX4732/MAX4733

## ELECTRICAL CHARACTERISTICS—Single +3V Supply (continued)

(V+ = +3V ±10%, V<sub>IH</sub> = +2.0V, V<sub>IL</sub> = +0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V+ = +3V, T<sub>A</sub> = +25°C.)  
(Notes 3, 4)

| PARAMETER                                   | SYMBOL                 | CONDITIONS                                                                                                   | T <sub>A</sub>                          | MIN    | TYP    | MAX | UNITS |
|---------------------------------------------|------------------------|--------------------------------------------------------------------------------------------------------------|-----------------------------------------|--------|--------|-----|-------|
| DYNAMIC CHARACTERISTICS                     |                        |                                                                                                              |                                         |        |        |     |       |
| Turn-On Time                                | t <sub>ON</sub>        | V <sub>NO_</sub> or V <sub>NC_</sub> = +1.5V,<br>R <sub>L</sub> = 300Ω,<br>C <sub>L</sub> = 35pF, Figure 2   | +25°C                                   | 70     | 150    | ns  |       |
|                                             |                        |                                                                                                              | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |        | 170    |     |       |
| Turn-Off Time                               | t <sub>OFF</sub>       | V <sub>NO_</sub> or V <sub>NC_</sub> = +1.5V,<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF,<br>Figure 2   | +25°C                                   | 30     | 60     | ns  |       |
|                                             |                        |                                                                                                              | T <sub>MIN</sub> to<br>T <sub>MAX</sub> |        | 70     |     |       |
| Break-Before-Make<br>(MAX4733 Only, Note 8) | t <sub>BBM</sub>       | V <sub>NO_</sub> or V <sub>NC_</sub> = +1.5V,<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF,<br>Figure 3   | +25°C                                   | 40     |        | ns  |       |
|                                             |                        |                                                                                                              | T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 1      |        |     |       |
| Charge Injection                            | Q                      | V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0, C <sub>L</sub> = 1.0nF,<br>Figure 4                             | +25°C                                   | 7.5    |        | pC  |       |
| On-Channel -3dB Bandwidth                   | BW                     | Signal = 0dBm, 50Ω in and out                                                                                | +25°C                                   | 300    |        | MHz |       |
| Off-Isolation (Note 9)                      | V <sub>ISO</sub>       | f = 1MHz, V <sub>COM_</sub> = 1V <sub>RMS</sub> ,<br>R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF,<br>Figure 5 | +25°C                                   | -72    |        | dB  |       |
| Crosstalk (Note 10)                         | V <sub>CT</sub>        | f = 1MHz, V <sub>COM_</sub> = 1V <sub>RMS</sub> ,<br>R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF,<br>Figure 6 | +25°C                                   | -108   |        | dB  |       |
| NO_ or NC_ Off-Capacitance                  | C <sub>OFF</sub>       | f = 1MHz, Figure 7                                                                                           | +25°C                                   | 20     |        | pF  |       |
| COM_ Off-Capacitance                        | C <sub>COM_(OFF)</sub> | f = 1MHz, Figure 7                                                                                           | +25°C                                   | 20     |        | pF  |       |
| COM_ On-Capacitance                         | C <sub>COM_(ON)</sub>  | f = 1MHz, Figure 7                                                                                           | +25°C                                   | 40     |        | pF  |       |
| LOGIC INPUT                                 |                        |                                                                                                              |                                         |        |        |     |       |
| Input Logic High                            | V <sub>IH</sub>        |                                                                                                              |                                         | 1.4    |        | V   |       |
| Input Logic Low                             | V <sub>IL</sub>        |                                                                                                              |                                         |        | 0.8    | V   |       |
| Input Leakage Current                       | I <sub>IN</sub>        | V <sub>IN_</sub> = 0V or V+                                                                                  |                                         | -1     | +0.005 | +1  | μA    |
| SUPPLY                                      |                        |                                                                                                              |                                         |        |        |     |       |
| Power-Supply Range                          | V+                     |                                                                                                              |                                         | 2.0    |        | 11  | V     |
| Positive Supply Current                     | I+                     | V+ = +5.5V, V <sub>IN_</sub> = 0V or V+,<br>all switches on or off                                           |                                         | 0.0001 |        | 1   | μA    |

# 50Ω, Dual SPST Analog Switches in UCSP

## ELECTRICAL CHARACTERISTICS—Single +5V Supply

(V+ = +5V ±10%, V<sub>IH</sub> = +2.0V, V<sub>IL</sub> = +0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V+ = +5V, T<sub>A</sub> = +25°C.)  
(Notes 3, 4)

| PARAMETER                                               | SYMBOL                                                     | CONDITIONS                                                                                                          | T <sub>A</sub>                                   | MIN        | TYP | MAX        | UNITS |
|---------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|------------|-----|------------|-------|
| <b>ANALOG SWITCH</b>                                    |                                                            |                                                                                                                     |                                                  |            |     |            |       |
| Analog Signal Range                                     | V <sub>COM_</sub> ,<br>V <sub>NO_</sub> , V <sub>NC_</sub> |                                                                                                                     |                                                  | 0          |     | V+         | V     |
| On-Resistance                                           | R <sub>ON</sub>                                            | V+ = +4.5V,<br>I <sub>COM_</sub> = 5mA,<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +3.5V                             | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 8.5        | 25  | 30         | Ω     |
| On-Resistance Matching<br>Between Channels (Notes 5, 6) | ΔR <sub>ON</sub>                                           | V+ = +4.5V,<br>I <sub>COM_</sub> = 5mA,<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +3.5V                             | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 0.2        | 3   | 4          | Ω     |
| On-Resistance Flatness<br>(Note 7)                      | R <sub>FLAT(ON)</sub>                                      | V+ = +4.5V,<br>I <sub>COM_</sub> = 5mA,<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +1V, +2V, +3V                     | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 2          | 5   | 7          | Ω     |
| NO_ or NC_ Off-Leakage Current<br>(Note 8)              | I <sub>NO_(OFF)</sub><br>I <sub>NC_(OFF)</sub>             | V+ = +5.5V,<br>V <sub>COM_</sub> = +1V, +4.5V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +4.5V, +1V                 | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -0.1<br>-2 |     | +0.1<br>+2 | nA    |
| COM_ Off-Leakage Current<br>(Note 8)                    | I <sub>COM_(OFF)</sub>                                     | V+ = +5.5V,<br>V <sub>COM_</sub> = +1V, +4.5V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +4.5V, +1V                 | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -0.1<br>-2 |     | +0.1<br>+2 | nA    |
| COM_ On-Leakage Current<br>(Note 8)                     | I <sub>COM_(ON)</sub>                                      | V+ = +5.5V,<br>V <sub>COM_</sub> = +1V, +4.5V;<br>V <sub>NO_</sub> or V <sub>NC_</sub> = +1V, +4.5V, or<br>floating | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | -0.2<br>-4 |     | +0.2<br>+4 | nA    |
| <b>DYNAMIC CHARACTERISTICS</b>                          |                                                            |                                                                                                                     |                                                  |            |     |            |       |
| Turn-On Time                                            | t <sub>ON</sub>                                            | V <sub>NO_</sub> or V <sub>NC_</sub> = +3.0V,<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF,<br>Figure 2          | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 47         | 85  | 95         | ns    |
| Turn-Off Time                                           | t <sub>OFF</sub>                                           | V <sub>NO_</sub> or V <sub>NC_</sub> = +3.0V,<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF,<br>Figure 2          | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 23         | 45  | 55         | ns    |
| Break-Before-Make<br>(MAX4733 Only, Note 8)             | t <sub>BBM</sub>                                           | V <sub>NO_</sub> or V <sub>NC_</sub> = +3.0V,<br>R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF,<br>Figure 3          | +25°C<br>T <sub>MIN</sub> to<br>T <sub>MAX</sub> | 25         | 1   |            | ns    |
| Charge Injection                                        | Q                                                          | V <sub>GEN</sub> = 0V, R <sub>GEN</sub> = 0,<br>C <sub>L</sub> = 1.0nF, Figure 4                                    | +25°C                                            |            | 7.5 |            | pC    |
| On-Channel Bandwidth                                    | BW                                                         | Signal = 0dBm,<br>50Ω in and out                                                                                    | +25°C                                            |            | 300 |            | MHz   |
| Off-Isolation (Note 9)                                  | V <sub>ISO</sub>                                           | f = 1MHz, V <sub>COM_</sub> = 1V <sub>RMS</sub> ,<br>R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF,<br>Figure 5        | +25°C                                            |            | -72 |            | dB    |

# 50Ω, Dual SPST Analog Switches in UCSP

MAX4731/MAX4732/MAX4733

## ELECTRICAL CHARACTERISTICS—Single +5V Supply

(V<sub>+</sub> = +5V ±10%, V<sub>IH</sub> = +2.0V, V<sub>IL</sub> = +0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at V<sub>+</sub> = +5V, T<sub>A</sub> = +25°C.) (Notes 3, 4)

| PARAMETER                  | SYMBOL                 | CONDITIONS                                                                                                  | T <sub>A</sub> | MIN | TYP    | MAX | UNITS |
|----------------------------|------------------------|-------------------------------------------------------------------------------------------------------------|----------------|-----|--------|-----|-------|
| Crosstalk (Note 10)        | V <sub>CT</sub>        | f = 1MHz, V <sub>COM</sub> = 1V <sub>RMS</sub> ,<br>R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF,<br>Figure 6 | +25°C          |     | -108   |     | dB    |
| NO_ or NC_ Off-Capacitance | C <sub>OFF</sub>       | f = 1MHz, Figure 7                                                                                          | +25°C          |     | 20     |     | pF    |
| COM_ Off-Capacitance       | C <sub>COM</sub> (OFF) | f = 1MHz, Figure 7                                                                                          | +25°C          |     | 20     |     | pF    |
| COM_ On-Capacitance        | C <sub>COM</sub> (ON)  | f = 1MHz, Figure 7                                                                                          | +25°C          |     | 40     |     | pF    |
| <b>LOGIC INPUT</b>         |                        |                                                                                                             |                |     |        |     |       |
| Input Logic High           | V <sub>IH</sub>        |                                                                                                             |                | 2.0 |        |     | V     |
| Input Logic Low            | V <sub>IL</sub>        |                                                                                                             |                |     |        | 0.8 | V     |
| Input Leakage Current      | I <sub>IN</sub>        | V <sub>IN</sub> = 0V or V <sub>+</sub>                                                                      |                | -1  | +0.005 | +1  | μA    |
| <b>SUPPLY</b>              |                        |                                                                                                             |                |     |        |     |       |
| Power-Supply Range         | V <sub>+</sub>         |                                                                                                             |                | 2.0 |        | 11  | V     |
| Positive Supply Current    | I <sub>+</sub>         | V <sub>+</sub> = +5.5V, V <sub>IN</sub> = 0V or V <sub>+</sub> ,<br>all switches on or off                  |                |     | 0.0001 | 1   | μA    |

**Note 3:** The algebraic convention, where the most negative value is a minimum and the most positive value a maximum, is used in this data sheet.

**Note 4:** UCSP and TDFN parts are 100% tested at +25°C only, and guaranteed by design over temperature. μMAX parts are 100% tested at +85°C and +25°C and guaranteed by design over temperature.

**Note 5:** ΔR<sub>ON</sub> = R<sub>ON</sub>(MAX) - R<sub>ON</sub>(MIN).

**Note 6:** UCSP on-resistance matching between channels and on-resistance flatness guaranteed by design.

**Note 7:** Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal range.

**Note 8:** Guaranteed by design.

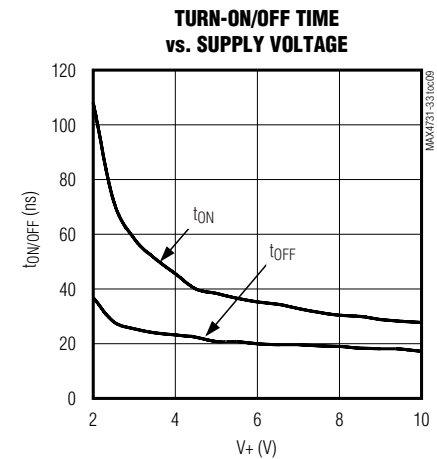
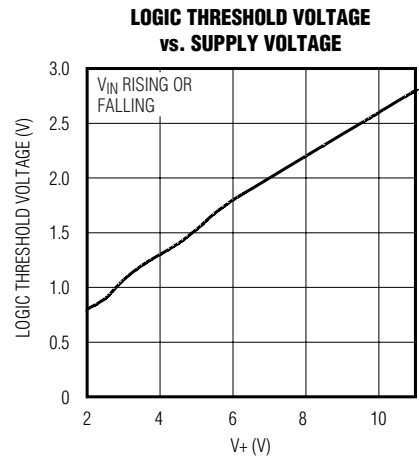
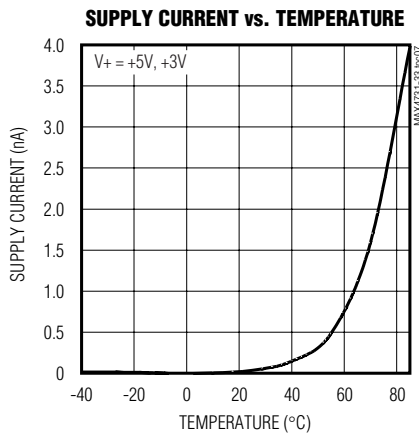
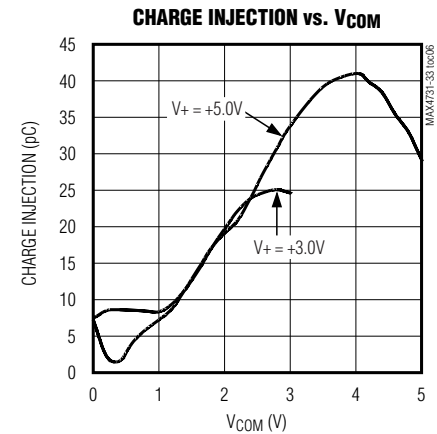
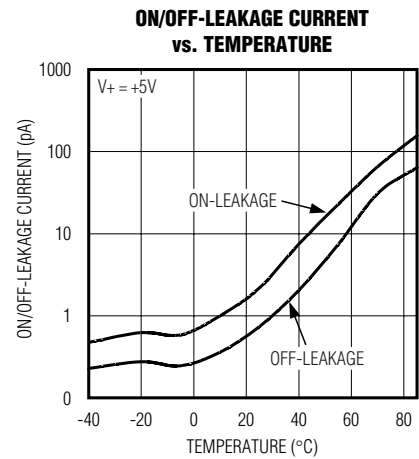
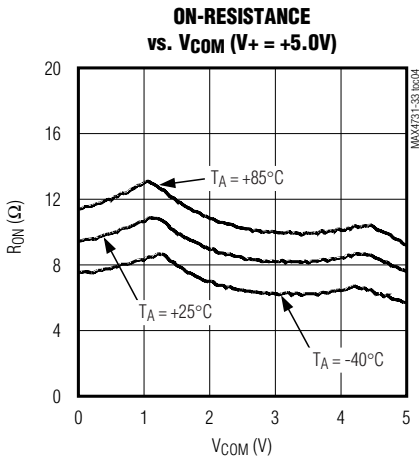
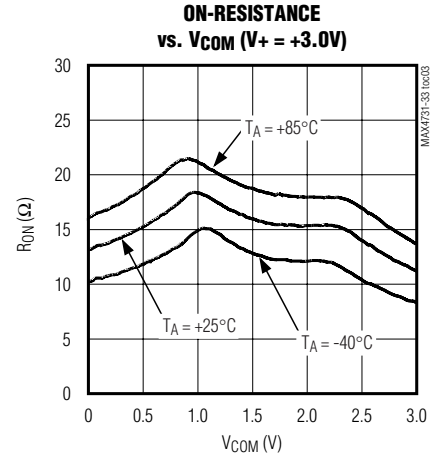
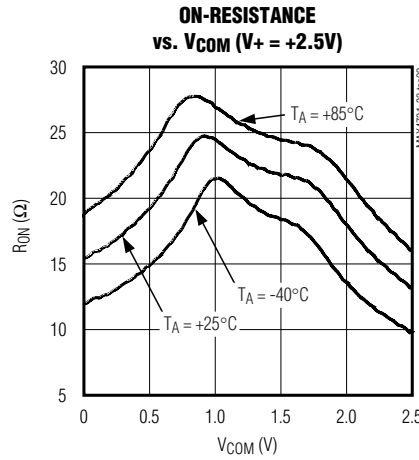
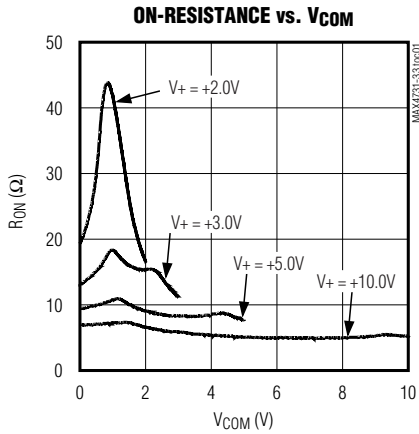
**Note 9:** Off-Isolation = 20 log<sub>10</sub> (V<sub>NO</sub>/V<sub>COM</sub>), V<sub>NO</sub> = output, V<sub>COM</sub> = input to off switch.

**Note 10:** Between any two switches.

# 50 $\Omega$ , Dual SPST Analog Switches in UCSP

## Typical Operating Characteristics

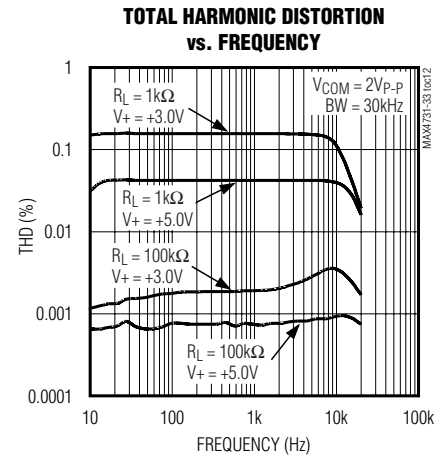
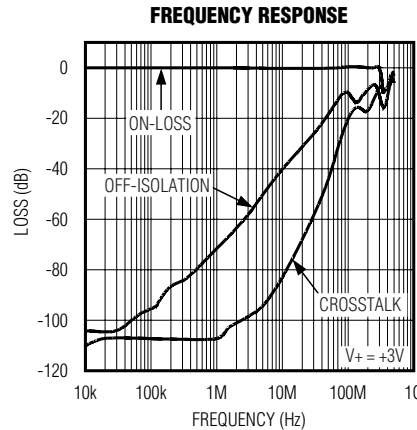
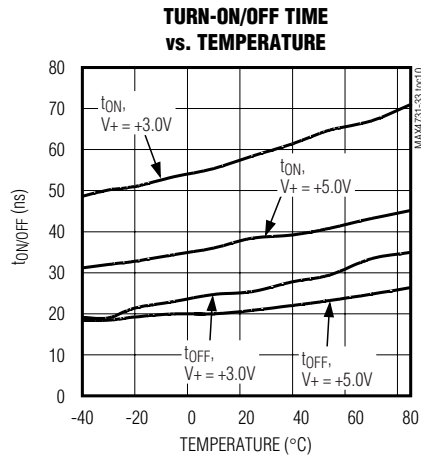
( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)



# 50Ω, Dual SPST Analog Switches in UCSP

## Typical Operating Characteristics (continued)

(T<sub>A</sub> = +25°C, unless otherwise noted.)



## Pin Description

| PIN     |                |         |                |         |                | NAME | FUNCTION                               |
|---------|----------------|---------|----------------|---------|----------------|------|----------------------------------------|
| MAX4731 |                | MAX4732 |                | MAX4733 |                |      |                                        |
| UCSP    | μMAX/<br>TDFN  | UCSP    | μMAX/<br>TDFN  | UCSP    | μMAX/<br>TDFN  |      |                                        |
| A1      | 1              | —       | —              | A1      | 1              | NO1  | Analog-Switch Normally Open Terminal   |
| A2      | 2              | A2      | 2              | A2      | 2              | COM1 | Analog-Switch Common Terminal          |
| A3      | 4              | A3      | 4              | A3      | 4              | GND  | Ground. Connect to digital ground.     |
| B1      | 7              | B1      | 7              | B1      | 7              | IN1  | Logic-Control Digital Input            |
| B3      | 3              | B3      | 3              | B3      | 3              | IN2  | Logic-Control Digital Input            |
| C1      | 8              | C1      | 8              | C1      | 8              | V+   | Positive Supply Voltage Input          |
| C2      | 6              | C2      | 6              | C2      | 6              | COM2 | Analog-Switch Common Terminal          |
| C3      | 5              | —       | —              | —       | —              | NO2  | Analog-Switch Normally Open Terminal   |
| —       | —              | A1      | 1              | —       | —              | NC1  | Analog-Switch Normally Closed Terminal |
| —       | —              | C3      | 5              | C3      | 5              | NC2  | Analog-Switch Normally Closed Terminal |
| —       | EP (TDFN only) | —       | EP (TDFN only) | —       | EP (TDFN only) | EP   | Exposed Pad. Connect to V+.            |

## Applications Information

### Operating Considerations for High-Voltage Supply

The MAX4731/MAX4732/MAX4733 operate to +11V with some precautions. The absolute maximum rating for V+ is +12V (referenced to GND). When operating near this region, bypass V+ with a minimum 0.1μF capacitor to ground as close to the IC as possible.

### Logic Levels

The MAX4731/MAX4732/MAX4733 are TTL compatible when powered from a single +5V supply. When powered from other supply voltages, the logic inputs should be driven rail-to-rail. For example, with a +11V supply, IN1 and IN2 should be driven low to 0V and high to 11V. With a +3.3V supply, IN1 and IN2 should be driven low to 0V and high to 3.3V. Driving IN1 and IN2 rail-to-rail minimizes power consumption.

## 50Ω, Dual SPST Analog Switches in UCSP

### Analog Signal Levels

Analog signals that range over the entire supply voltage (GND to V+) pass with very little change in  $R_{ON}$  (see *Typical Operating Characteristics*). The bidirectional switches allow NO<sub>-</sub>, NC<sub>-</sub>, and COM<sub>-</sub> connections to be used as either inputs or outputs.

### Power-Supply Sequencing and Overvoltage Protection

**CAUTION:** Do not exceed the absolute maximum ratings. Stresses beyond the listed ratings can cause permanent damage to the devices.

Proper power-supply sequencing is recommended for all CMOS devices. Always apply V+ before applying analog signals, especially if the analog signal is not current limited. If this sequencing is not possible, and if the analog inputs are not current limited to < 20mA, add a small-signal diode, D1, as shown in Figure 1. If the analog signal can dip below GND, add D2. Adding protection diodes reduces the analog signal range to a diode drop (about 0.7V) below V+ (for D1), and to a diode drop above ground (for D2). Leakage is unaffected by adding the diodes. On-resistance increases slightly at low supply voltages. Maximum supply voltage (V+) must not exceed +11V.

Adding protection diodes causes the logic thresholds to be shifted relative to the power-supply rails. The most significant shift occurs when using low supply voltages (+5V or less). With a +5V supply, TTL compatibility is not guaranteed when protection diodes are added. Driving IN1 and IN2 all the way to the supply rails (i.e., to a diode drop higher than the V+ pin, or to a diode drop lower than the GND pin) is always acceptable.

Protection diodes D1 and D2 also protect against some overvoltage situations. Using the circuit in Figure 1, no damage results if the supply voltage is below the absolute maximum rating (+12V) and if a fault voltage up to the absolute maximum rating (V+ + 0.3V) is applied to an analog signal terminal.

### UCSP Applications Information

For the latest application details on UCSP construction, dimensions, tape carrier information, printed circuit board techniques, bump-pad layout, and recommended reflow temperature profile as well as the latest information on reliability testing results, go to the Maxim web site at [www.maxim-ic.com/ucsp](http://www.maxim-ic.com/ucsp) to find the Application Note: UCSP—A Wafer-Level Chip-Scale Package.

### Test Circuits/Timing Diagrams

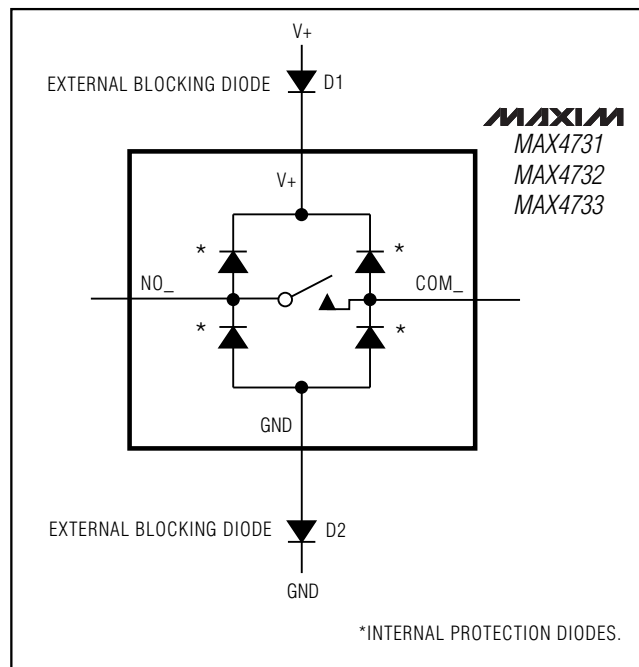


Figure 1. Overvoltage Protection Using External Blocking Diodes



# 50Ω, Dual SPST Analog Switches in UCSP

## Test Circuits/Timing Diagrams (continued)

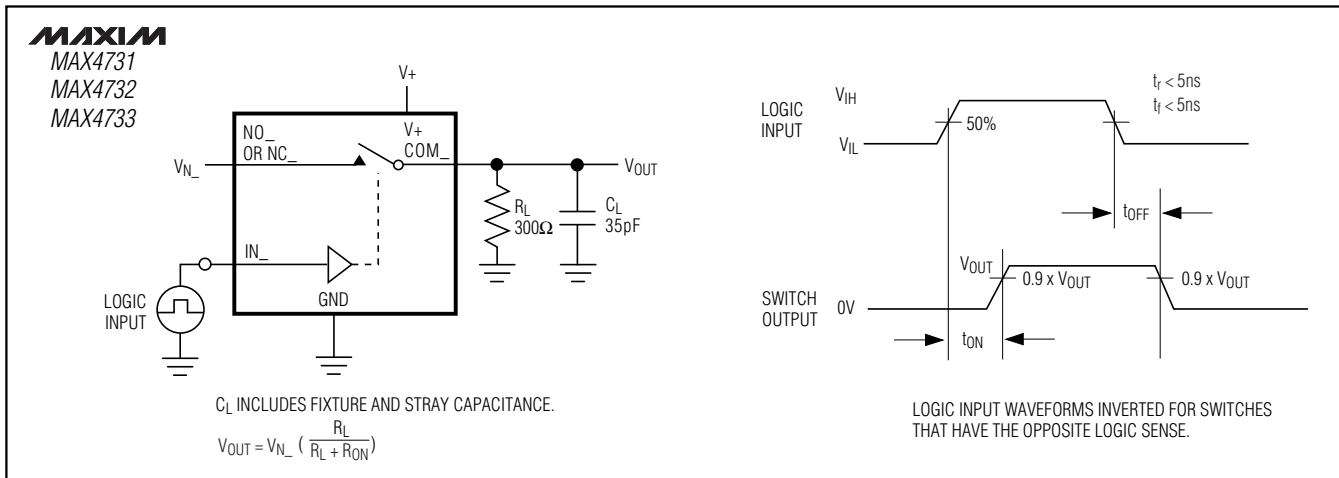


Figure 2. Switching Time

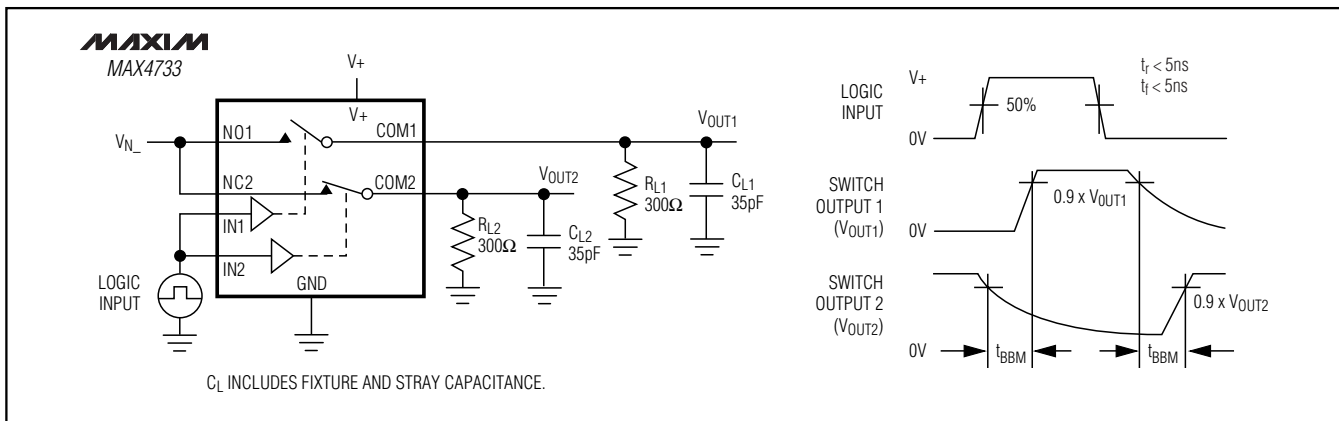


Figure 3. Break-Before-Make Interval (MAX4733 only)

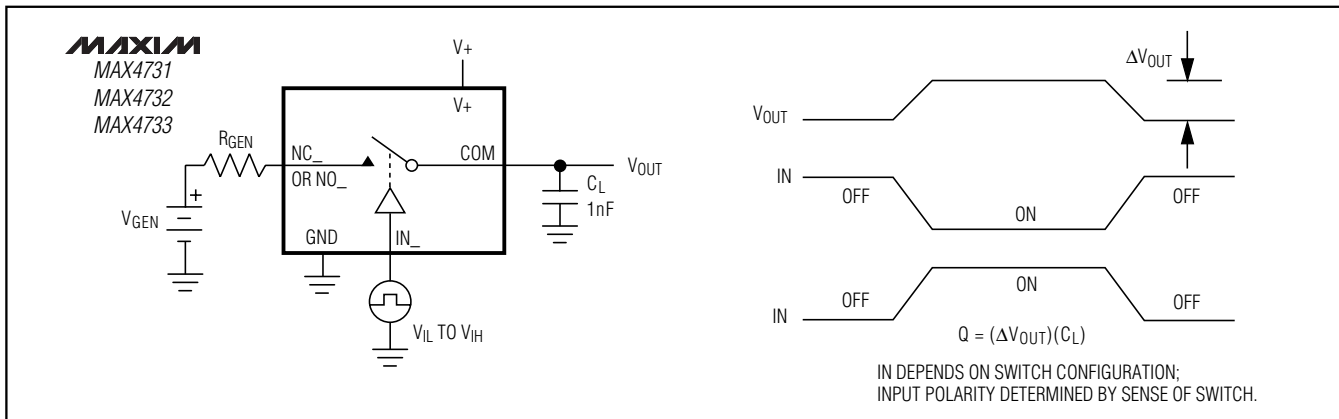


Figure 4. Charge Injection

# 50Ω, Dual SPST Analog Switches in UCSP

## Test Circuits/Timing Diagrams (continued)

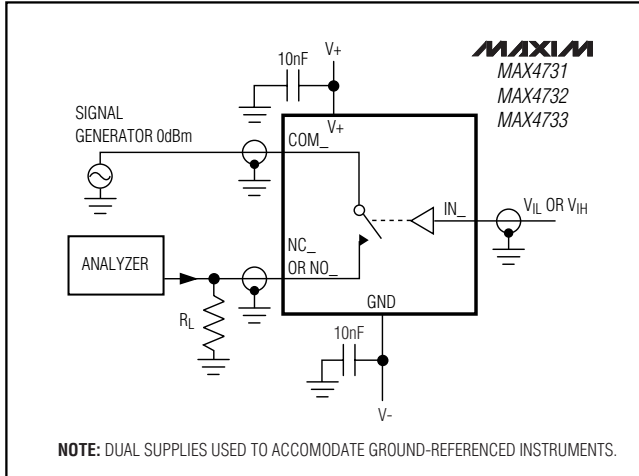


Figure 5. Off-Isolation/On-Channel Bandwidth

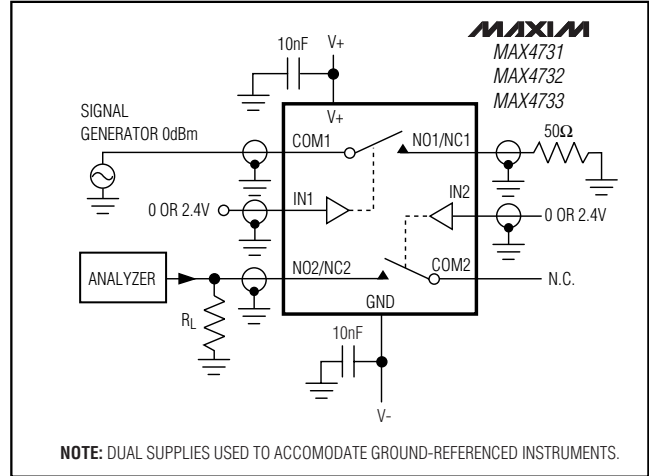


Figure 6. Crosstalk

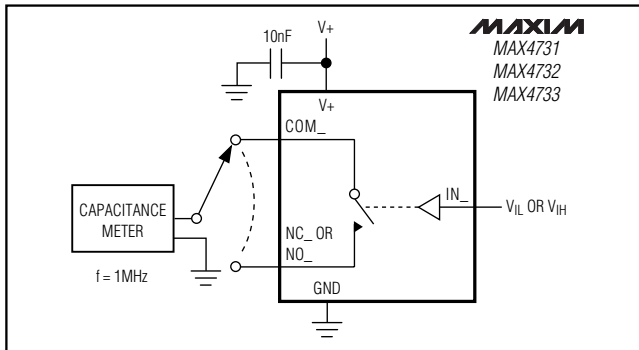


Figure 7. Channel Off/On-Capacitance

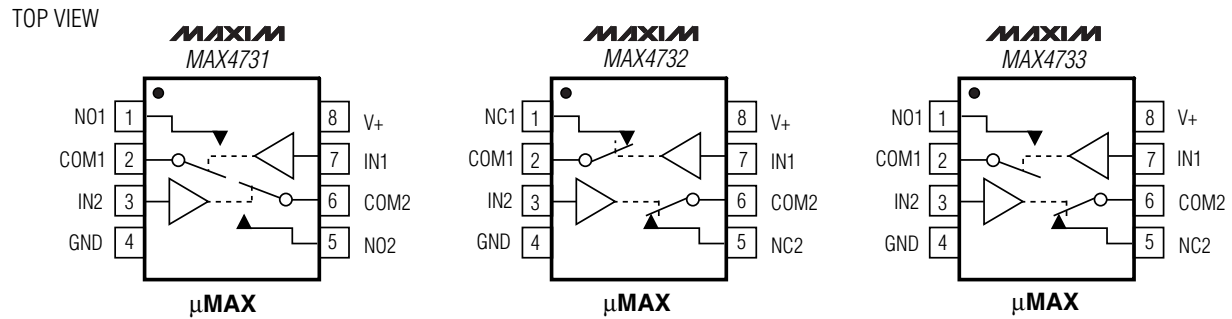
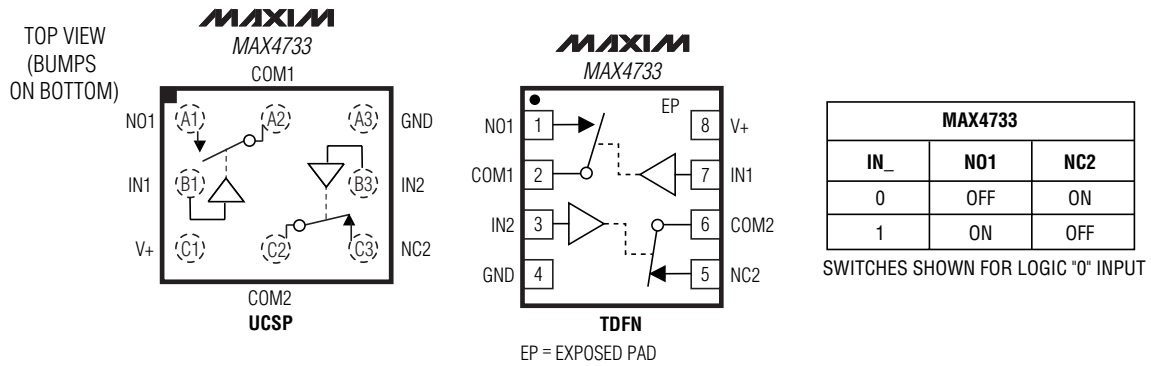
## Chip Information

TRANSISTOR COUNT: 68

PROCESS: CMOS

# 50Ω, Dual SPST Analog Switches in UCSP

## Pin Configurations/Functional Diagrams/Truth Tables (continued)

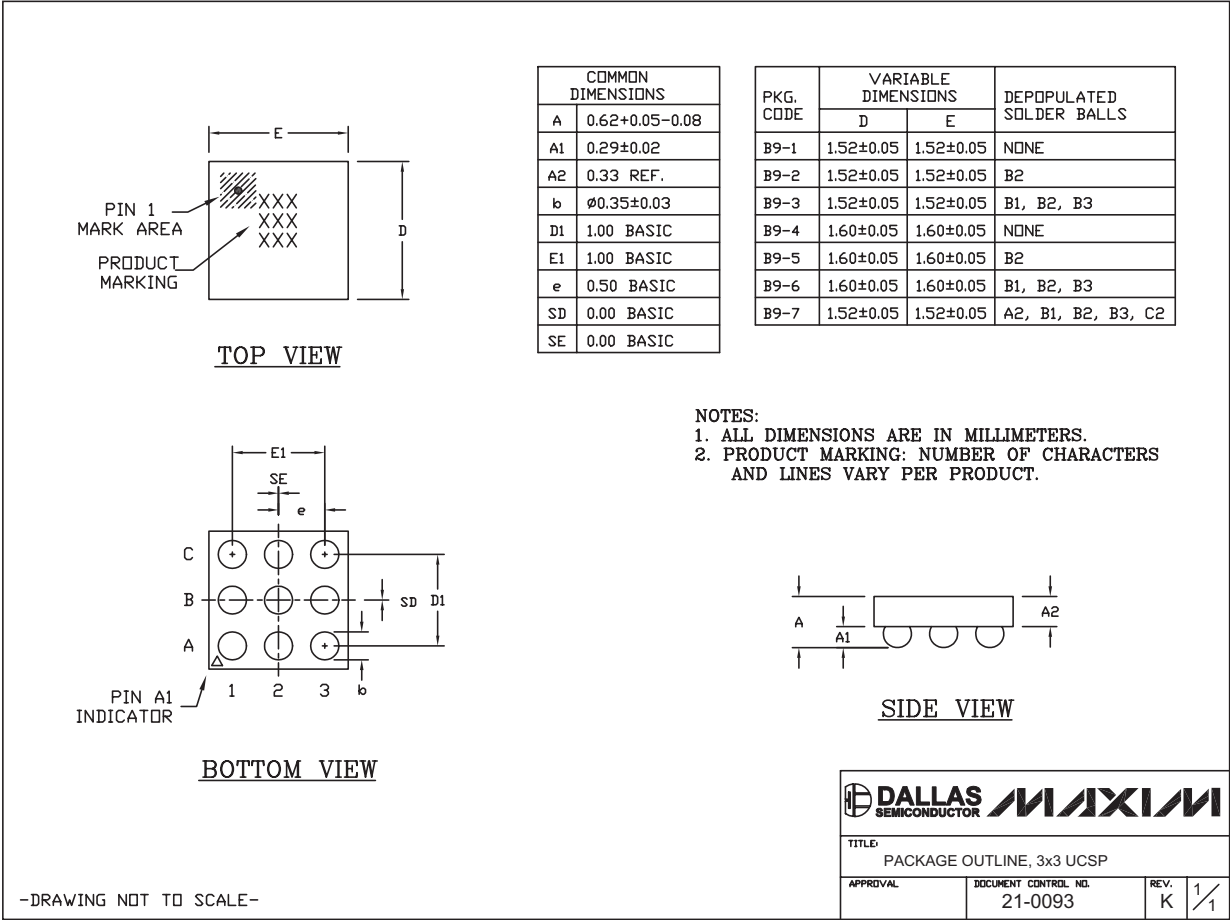


MAX4731/MAX4732/MAX4733

# 50Ω, Dual SPST Analog Switches in UCSP

## Package Information

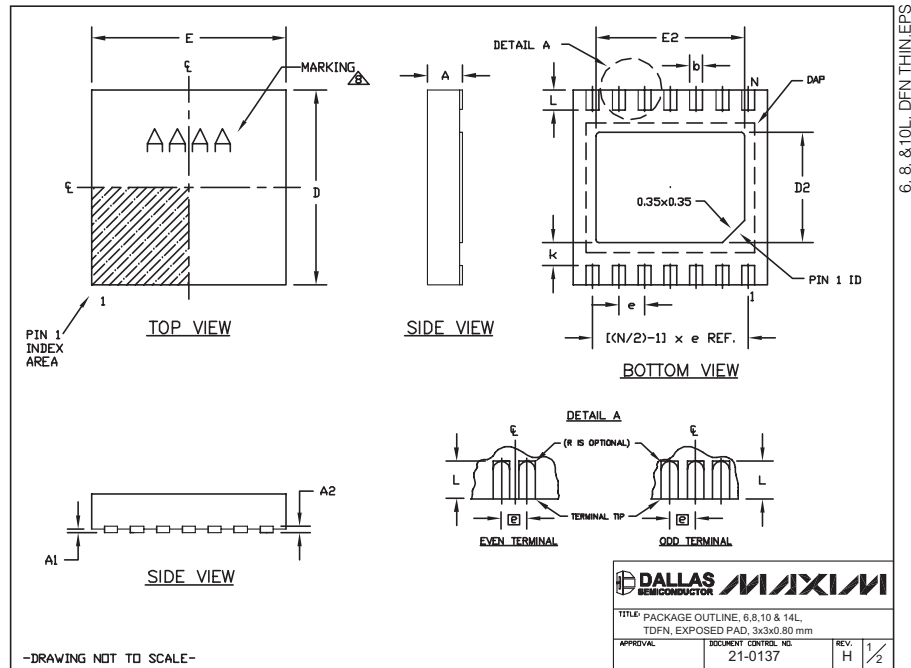
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



9LUCSP, 3x3 EPS

**MAX4731/MAX4732/MAX4733**

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



| COMMON DIMENSIONS |           |      |
|-------------------|-----------|------|
| SYMBOL            | MIN.      | MAX. |
| A                 | 0.70      | 0.80 |
| D                 | 2.90      | 3.10 |
| E                 | 2.90      | 3.10 |
| A1                | 0.00      | 0.05 |
| L                 | 0.20      | 0.40 |
| k                 | 0.25 MIN. |      |
| A2                | 0.20 REF. |      |

| PACKAGE VARIATIONS |    |           |           |          |                |           |               |
|--------------------|----|-----------|-----------|----------|----------------|-----------|---------------|
| PKG. CODE          | N  | D2        | E2        | e        | JEDEC SPEC     | b         | [(N/2)-1] x e |
| T633-1             | 6  | 1.50-0.10 | 2.30-0.10 | 0.95 BSC | MO229 / WEEA   | 0.40-0.05 | 1.90 REF      |
| T633-2             | 6  | 1.50-0.10 | 2.30-0.10 | 0.95 BSC | MO229 / WEEA   | 0.40-0.05 | 1.90 REF      |
| T833-1             | 8  | 1.50-0.10 | 2.30-0.10 | 0.65 BSC | MO229 / WEEC   | 0.30-0.05 | 1.95 REF      |
| T833-2             | 8  | 1.50-0.10 | 2.30-0.10 | 0.65 BSC | MO229 / WEEC   | 0.30-0.05 | 1.95 REF      |
| T833-3             | 8  | 1.50-0.10 | 2.30-0.10 | 0.65 BSC | MO229 / WEEC   | 0.30-0.05 | 1.95 REF      |
| T1033-1            | 10 | 1.50-0.10 | 2.30-0.10 | 0.50 BSC | MO229 / WEED-3 | 0.25-0.05 | 2.00 REF      |
| T1033-2            | 10 | 1.50-0.10 | 2.30-0.10 | 0.50 BSC | MO229 / WEED-3 | 0.25-0.05 | 2.00 REF      |
| T1433-1            | 14 | 1.70-0.10 | 2.30-0.10 | 0.40 BSC | ----           | 0.20-0.05 | 2.40 REF      |
| T1433-2            | 14 | 1.70-0.10 | 2.30-0.10 | 0.40 BSC | ----           | 0.20-0.05 | 2.40 REF      |

NOTES:

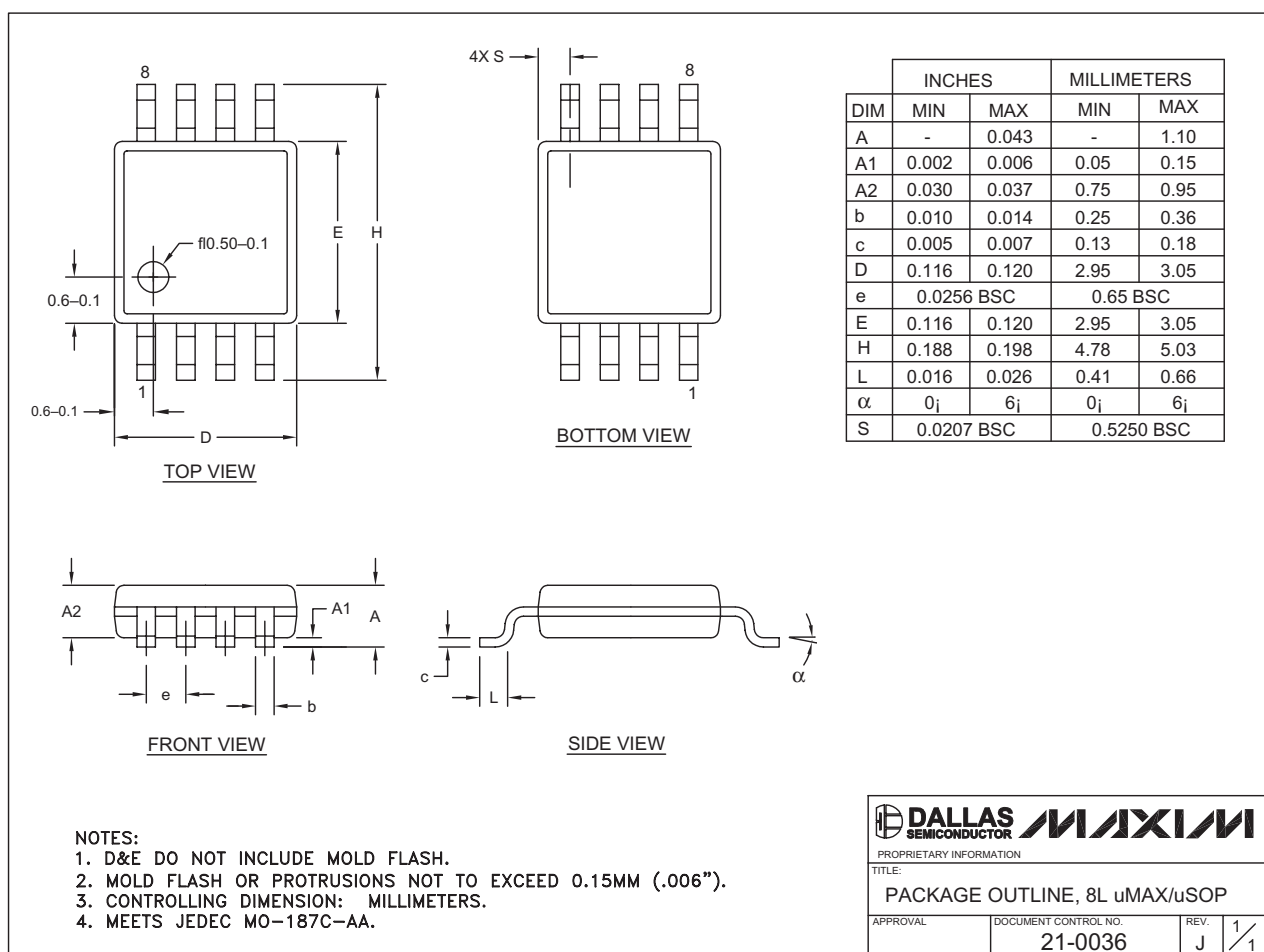
1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. COPLANARITY SHALL NOT EXCEED 0.08 mm.
3. WARPAGE SHALL NOT EXCEED 0.10 mm.
4. PACKAGE LENGTH/PACKAGE WIDTH ARE CONSIDERED AS SPECIAL CHARACTERISTIC(S).
5. DRAWING CONFORMS TO JEDEC MO229, EXCEPT DIMENSIONS "D2" AND "E2", AND T1433-1 & T1433-2.
6. "N" IS THE TOTAL NUMBER OF LEADS.
7. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY.
8. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.



# 50Ω, Dual SPST Analog Switches in UCSP

## Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



## Revision History

Pages changed at Rev 2: 1, 2, 7, 8, 11, 14

Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

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